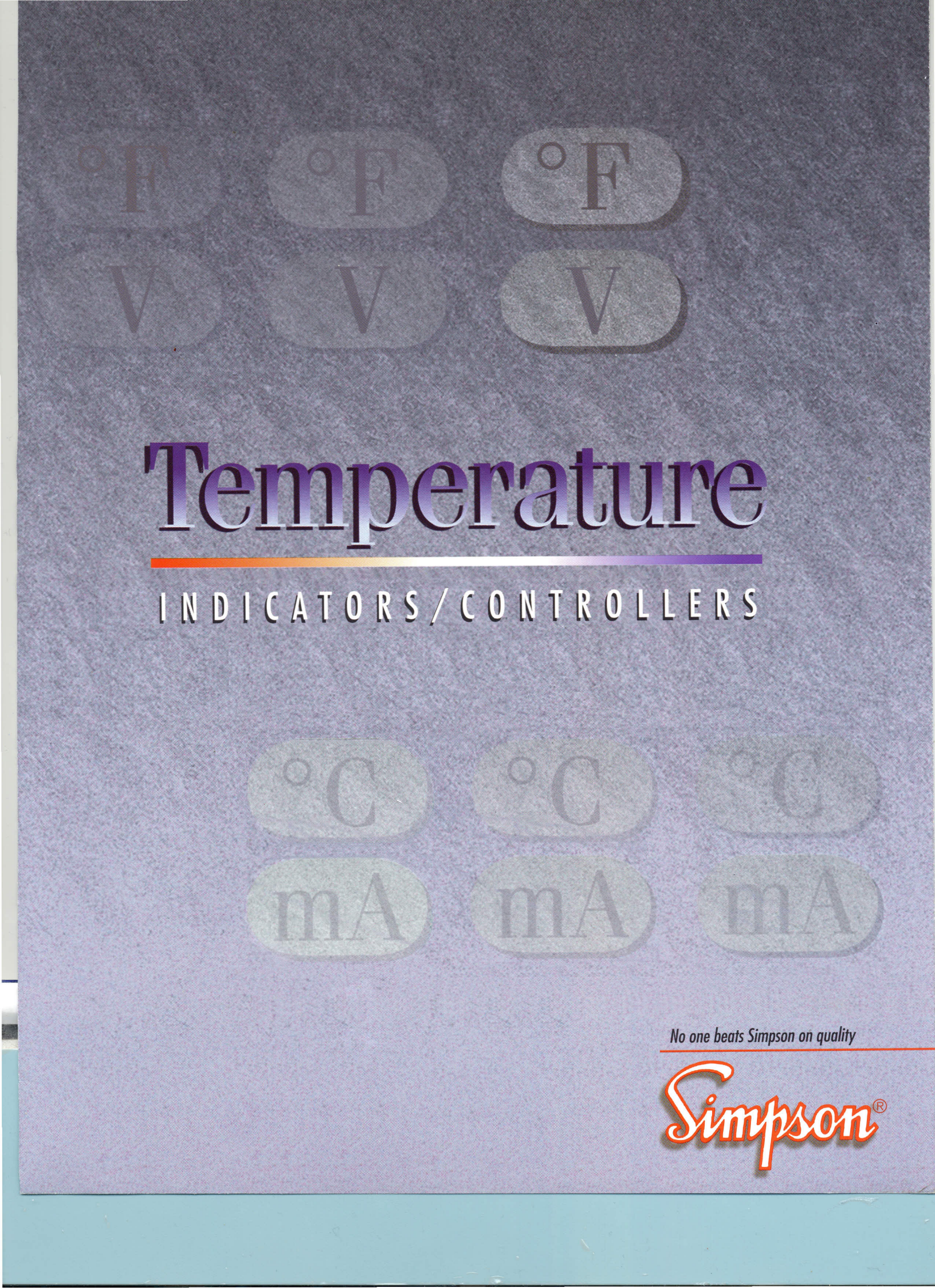


# Temperature

## INDICATORS/CONTROLLERS

*No one beats Simpson on quality*

Simpson®

# DIGITAL CONTROLLERS

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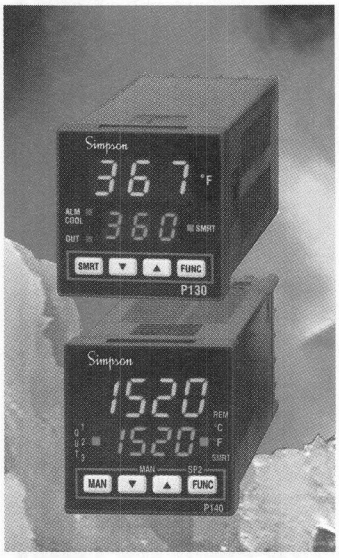
No one beats Simpson on quality

## Phoenix P130 & P140

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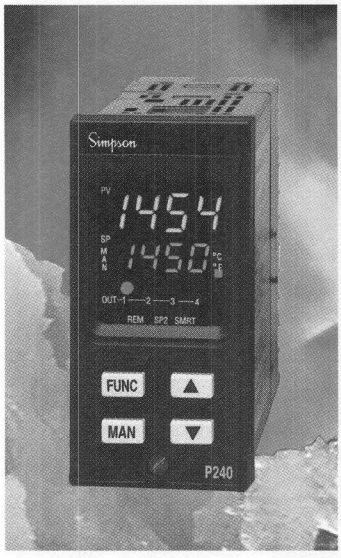
## Phoenix P240

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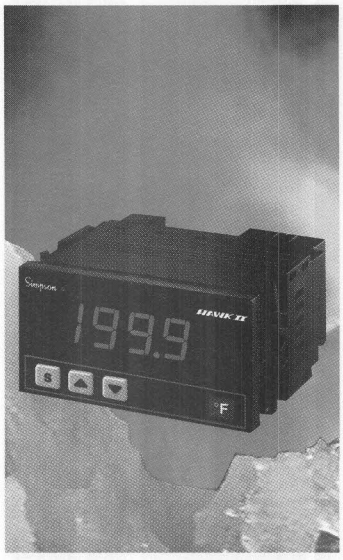
## Hawk II H235

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| | | | |
|---|---|---|---|
| Display | 3, 4 DIGIT LED | 4 DIGIT LED | 3 1/2 DIGIT LED |
| Inputs | (3 DIGIT P130)<br>T/C: J, K, L, N; RTD: Pt100<br>(4 DIGIT P140)<br>T/C: J, K, L, N, R, S; RTD: Pt100<br>LINEAR: mV, mA, V | T/C: J, K, L, N, R, S<br>RTD: Pt100<br>LINEAR: mV, mA, V | T/C: J, K<br>RTD: Pt100 |
| Power Supply | 100-240 VAC | 100-240 VAC | 110/220 VAC<br>10-55 VDC |
| Panel Cutout & Depth | 1.8" x 1.8"<br>(45 mm x 45 mm)<br>3.9"/4.8"<br>(100mm/122mm) | 1.8" x 3.6"<br>(45 mm x 92 mm)<br>4.6"(116 mm) | 3.6" x 1.8"<br>(92 mm x 45 mm)<br>3.24"(82 mm) |
| Output Signals | N/A | N/A | ANALOG, EXCITATION<br>(12 & 24 VDC) |
| Control Action | PID SMART TUNE | PID SMART TUNE | ON/OFF |
| Relays | 2 OR 3 | 3 OR 4 | 1 OR 2 |
| Nema 4/IP65 | YES | YES | YES |

# DIGITAL CONTROLLERS / DIGITAL INDICATORS

# ACCESSORIES

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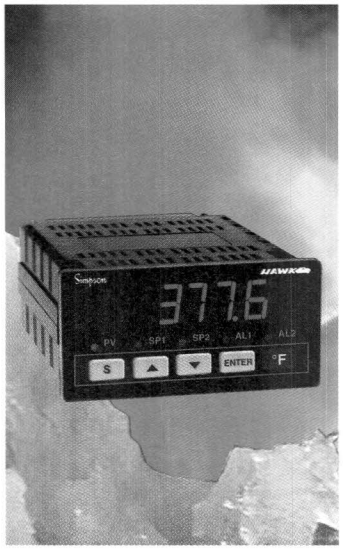
## Hawk HK35 & HK45

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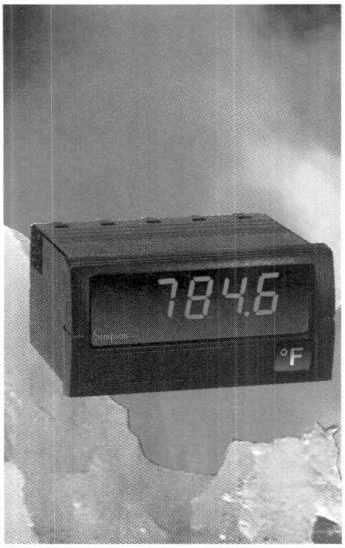
## Falcon F45

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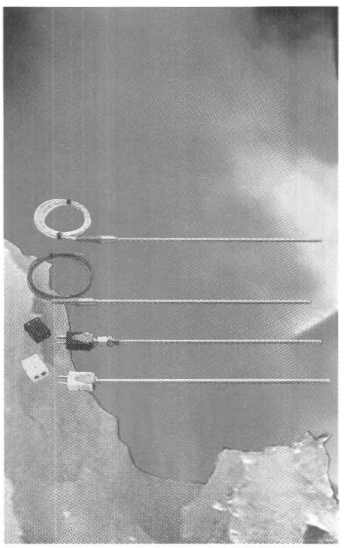
## Thermocouples



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| | Hawk HK35 & HK45 | Falcon F45 | Thermocouples |
|---|---|---|---|
| Display | 3½, 4½ DIGIT LED | 4½ DIGIT LED | N/A |
| Inputs | T/C: J, K, R, S<br>RTD: Pt100, Ni100 | T/C: J, K, S, T, E, R<br>RTD: Pt100<br>LINEAR: mV | J, K, T, E<br>SOFT WIRE, QUICK-DISCONNECT OR METAL TRANSITION |
| Power Supply | 24/48/110/220 VAC<br>9-32 VDC | 110 / 220 VAC<br>9-32 VDC | N/A |
| Panel Cutout & Depth | 3.6" x 1.8"<br>(92 mm x 45 mm)<br>5.35"(136 mm) | 3.6" x 1.8"<br>(92 mm x 45 mm)<br>3.01"(76.5 mm) | PROBES: 48"<br>SOFT WIRE: Custom lengths available |
| Output Signals | ANALOG, DIGITAL, EXCITION | EXCITATION (12 & 24 VDC) | N/A |
| Control Action | ON/OFF | N/A | N/A |
| Relays | 1 OR 2 | N/A | N/A |
| Nema 4/IP65 | OPTIONAL COVER | YES | N/A |

# Temperature Controllers

## Phoenix P130 PID Controller
## 3 Digit 1/16 DIN

- *Easily Programmed From the Front Panel*
- *SMART Auto-tuning for Automatic Adjustment and Continuous Tuning of Optimum Control Parameters*
- *Full PID or On/Off Control*
- *Dual Display: Both Measurement and Set Point Values*
- *Choice of T/C or RTD inputs (J, K, L, N, or RTD Pt100)*
- *Two Outputs Standard*
- *Alarm Option: Choice of Process, Band, Deviation or Instrument Failure Indicator Alarm*
- *IP65 / Nema 4X Protection*
- *Standard Screw Terminal Connector With Safety Cover*

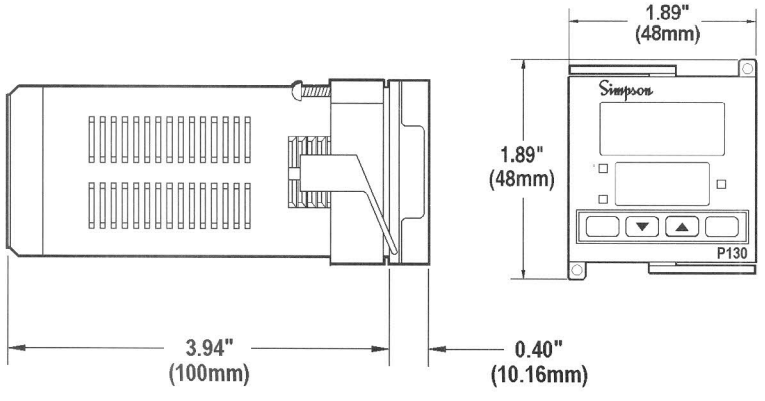

Simpson's new Phoenix Series PID controllers offer ease of use and full PID control for a variety of thermocouple and RTD inputs. The controller can operate in the standard PID control mode for both heating and cooling, with on-demand SMART Tuning to automatically set the optimum PID parameters. The P, I, and D actions are also manually adjustable over a wide range. On/Off control operation is keypad-selectable.

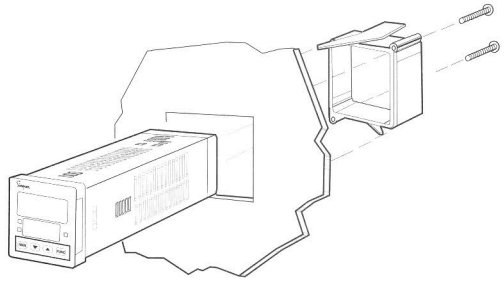
Two outputs are standard on the P130, allowing for both heating and cooling control. The second output can be configured as an alarm in lieu of a cooling output. A process, band, or deviation alarm or an instrument failure indicator may be selected. The safety lock feature provides password protection.

Model P130 features a dual, 3-digit LED display with LED indicators for output and alarm status. Screw terminal connectors are standard for easy wiring, and a rear safety cover is included.

The model P130 fits the standard 1/16 DIN panel cutout (45mm X 45mm) and requires only 100mm depth behind the panel. The front panel offers IP65/Nema 4X protection.

## Installation and Panel Cutout



**Mounting Instructions**
Insert the Phoenix into the panel cutout through the front. From behind the panel, slide the white mounting bracket over the Phoenix, gently pulling the tabs out to move the bracket. The mounting screws and tabs should be on the top and bottom of the controller. Push the bracket forward until it is flush with the panel, then tighten the mounting screws to hold the Phoenix in place.

## Specifications

**DISPLAY**
**Type:** Dual 3-digit LED
Upper (yellow-green): Process measurement value
Lower (orange): Set point value

**POWER REQUIREMENTS**
**AC Voltages:** 100 to 240 VAC +10/-15%, 50/60 Hz
OR 24 VAC +10/-15%
**DC Voltages:** 24 VDC +10/-15%
*NOTE: 24V AC/DC is available on special order.*
**Power Consumption:** 5 VA

**ACCURACY @ 25°C**
±0.3% of full scale ±1 digit

**ENVIRONMENTAL**
**Operating Temperature:** 0 to 50°C
**Storage Temperature:** -30 to 70°C
**Relative Humidity:** 20 to 85% non-condensing
**Warm-up Time:** None required

**NOISE REJECTION**
**NMRR:** 60 dB, 50/60 Hz
**CMRR:** 120 dB, 50/60 Hz

**ANALOG TO DIGITAL CONVERSION**
**Technique:** Dual slope integration
**Sampling Time:** 500ms typical

**INPUT: THERMOCOUPLE**
**Types:** J, K, L, N (either °C or °F)
**Cold Junction Compensation:** automatic from 0 to 50°C ambient temperature
**Input Impedance:** 100Ω max.
**Resolution:** 1° C; 1° F

**INPUT: RTD** (.00385 alpha)
**Type:** Pt100 3-wire (either °C or °F)
**Line Resistance:** < 4Ω per wire
**Resolution:** 0.1° or 1° C; 1° F

**MECHANICAL**
**Bezel:** 1.9" x 1.9" (48 x 48 mm)
**Depth:** 3.9" (100 mm)
**Panel Cut-out:** 1.8" x 1.8" (45 x 45 mm 1/16 DIN)
**Case Material:** grey ABS
**Front Panel:** IP65, Nema 4X protection in accordance with CEI 70-1 requirements
**Weight:** 5.1 oz. (160 g)

**CONTROL CHARACTERISTICS**
**Control Method:** PID with SMART Tune for Auto and Adaptive tuning, or ON/OFF. Choose ON/OFF Control by setting Proportional Band = 0
**Proportional Band:** Programmable from 1.0% to 99.9% of the configured input span
**Integral Time:** Programmable from 1 minute 20 seconds to 20.0 minutes, or excluded
**Derivative Time:** Programmable from 1 second to 9 minutes 59 seconds, or excluded
**Output 1 (Heating) Cycle Time:** Programmable from 1 to 200 seconds
**Hysteresis (for ON/OFF control):** Programmable from 0.1% to 10.0% of the configured input span

**In the Case of 2 Control Outputs:**
**Relative Cooling Gain:** Programmable from 0.20 to 1.00
**Cooling cycle time:** Programmable from 1 to 200 seconds
**Overlap/deadband:** Programmable from -20% (deadband) to +50% (overlap) of the proportional band
NOTE: These Output 2 parameters will be automatically set during configuration according to the cooling medium (air, oil, or water) selected.

**CONTROL OUTPUTS**
**Type:** One (Heating or Cooling) or Two (#1 Heating, #2 Cooling)
**Direct/Reverse Action:** Programmable
**Output Status Indication:** Red LED indicators on the front panel are lit when their respective output is in the ON condition. OUT indicates heating cycle is on, while ALM/COOL indicates cooling cycle is on.
**Output Level Limiter:** Programmable from 0% to 100% of the output span. Operates at start-up for programmed time to avoid thermal shock.
**Relay Outputs:**
**Output cycle time:** Programmable from 1 to 200 seconds
**Heating Output:** 3 Amp, 250 VAC SPDT contact
**Cooling Output:** 1 Amp, 250 VAC SPST contact

**Logic Voltage for SSR Driver (Output 1 only):**
**Logic Level 0:** Vout < 0.5 VDC
**Logic Level 1:**
14 VDC ± 20% @ 20 mA max.
24 VDC ± 20% @ 1 mA max.

**OUTPUT POWER OFF FUNCTION**
This function allows the instrument to operate as an indicator by disabling the control output, removing power from the controlled load. It is therefore possible to continue monitoring the process variable even if the load is off.

**ALARM**
An Alarm may be selected in lieu of Output 2.
**Alarm Functions:** Process alarm, Band alarm, Deviation alarm, or Instrument failure indicator
**Alarm Reset:** Automatic reset
**Masking:** Alarm can be configured as masked, to avoid false alarm indication at start-up or after a set point change
**Alarm Indication:** ALM/COOL LED indicator is lit when the alarm is ON
**Alarm Output:** 1 Amp, 250 VAC SPST contact
**Operational Mode:** Programmable
Process alarm: high or low
Band alarm: outside or inside
Deviation alarm: high or low
**Threshold:** Programmable
**Hysteresis:** Programmable from 0.1% to 10.0% of the configured input span

## Control Action

**ON / OFF CONTROL**

This is the simplest form of temperature control. An ON/OFF controller switches the output when the temperature crosses the set point. For heating applications, the output is ON (at 100%) below the set point and OFF (at 0%) above the set point; the opposite is true for cooling applications.

If the ON and OFF points were actually the same, the relay would cycle rapidly as the process temperature crossed the set point. To prevent this "chatter," a deadband, or Hysteresis, is added to the control operation. This Hysteresis sets a band around the set point that the temperature must cross before the output can be switched on or off again, eliminating rapid cycling.

The Phoenix can be configured for ON/OFF control by entering the Operation Parameter mode and setting the Proportional Band (Pb) = 0.

**PID CONTROL**

PID Control adds Proportional, Integral and Derivative action to ON/OFF Control in order to more closely regulate the process temperature. It is recommended for processes subject to wide temperature cycling or sudden changes in process temperature or load.

**Proportional Action** adjusts the output as soon as the process temperature enters a selected **Proportional Band** around the set point. The output is controlled proportionally to the difference between the set point and the actual process temperature. As the measured value approaches the set point, the output level gradually decreases until the temperature stabilizes.

In reality, Proportional Action usually brings the process temperature very close but not exactly to the set point. This difference is called "offset".

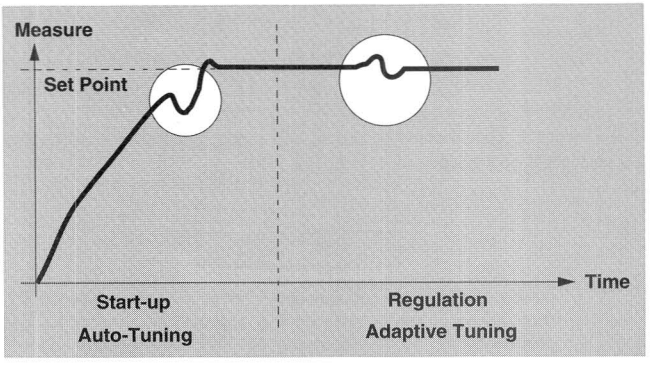
**Integral Action** automatically corrects this offset by measuring the difference between the set point and the measured value and then shifting the Proportional Band accordingly. Integral Action is expressed in minutes and seconds, representing the time needed to reset the Proportional Band. For this reason, Integral Action is often referred to as "reset".

**Derivative Action** enables the controller to react to rapid changes in the process temperature -- for example, a sudden rush of cooler material into the flow. The output is adjusted in proportion to the rate of change in the process temperature over the set derivative time. Derivative Action is therefore often referred to as "rate".

With the Simpson Phoenix PID controller, the PID values can be selected by the user in the Operation parameter setting mode. However, SMART Tuning will monitor the process and automatically set the optimum PID parameters.

## SMART Tuning

Simpson's Phoenix PID controller is equipped with a SMART self-tuning algorithm. SMART Tuning enables the controller to automatically adjust the PID parameters to the optimum levels according to the process conditions.




**At Start-Up**

SMART implements auto-tuning function to calculate optimum PID values for best approach to set point.

**During Regulation**

SMART continually monitors the process and updates the PID parameters as the Phoenix adapts to changes in either set point or load.

To enable SMART Tuning, make sure the instrument is in normal display mode, then press SMRT. The SMART LED indicator will be flashing during auto-tuning and lit during continuous adaptive tuning.

NOTE: While the SMART Tuning function is enabled, the control parameters (Pb, ti, td, rC) may be displayed but not modified.

To disable SMART Tuning, press SMRT again. The SMART LED indicator will turn off. The control parameters may be modified when SMART Tuning is disabled.

## Soft Start

Simpson's Phoenix PID controller is equipped with a Soft Start function to gradually warm up the process temperature. Soft Start takes effect immediately at start-up, limiting the output power level in order to avoid thermal shock.

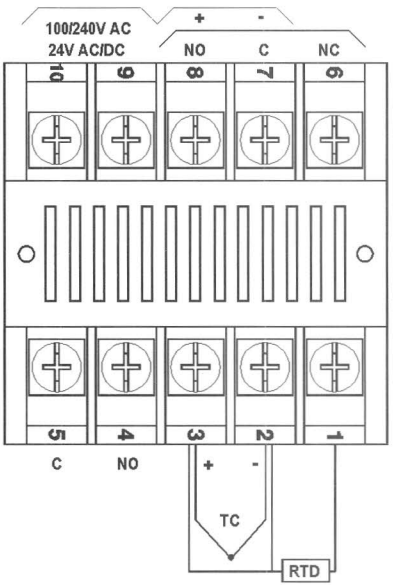
Output during Soft Start is determined according to the Output High Limit (OLH) and Output 1 Cycle Time (C) operating parameters. OLH sets the percentage of the cycle time that the output power will be ON during Soft Start. For example, if C = 15 seconds and OLH was set at 50%, then the heating output would only be ON for a maximum of 7.5 seconds during Soft Start.

## Wiring Diagram

**Supply Power:** Connect the power (100-240 VAC or 24V AC/DC) to terminals #9 and #10.

**Input Signal:**
Thermocouples are connected to terminals #2 and #3.
RTDs are connected to terminals #1, #2, and #3.

**Outputs:**
Output 1 (main Heating or Cooling output) is connected to terminals #6, #7, and #8 as follows: #6 for NC, #7 for C ( - for SSR), and #8 for NO ( + for SSR).
Output 2 (Cooling output or Alarm output) is connected to terminals #4 (NO) and #5 (C).




**WARNING**

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

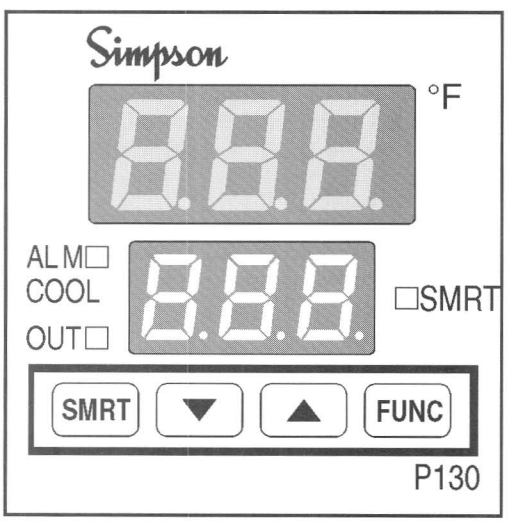
**CAUTION**

The Solid State Relay option (SSR) is a logic voltage for a SSR driver. Be sure to connect to a SSR driver and not directly to the load.

**CAUTION**

Before switching the instrument on, make sure the supply voltage is within the range required as indicated on the hook-up label affixed to the instrument.

## P130 Display




**DISPLAY**
**Upper Display:** Process measurement value (yellow-green)
**Lower Display:** Set point value (orange)

**KEYPAD DESCRIPTION**

▼ Decreases the selected parameter value.

▲ Increases the selected parameter value.

FUNC Displays parameters in sequence and enters new values.

SMRT Turns SMART Tuning on or off.

▲ + FUNC Enables/Disables the OUTPUT POWER OFF function.

**LED INDICATORS**

**SMRT** Indicates SMART Tuning function is active. Flashes during auto-tuning. Lit during adaptive tuning.

**OUT** Indicates OUTPUT 1 (Main Output) is ON.

**ALM/ COOL** Indicates OUTPUT 2 is ON, if Cooling Output is selected, OR Indicates Alarm is ON, if Alarm is selected.

# Operation

## SIMPLE SET-UP

Starting PID Control can be accomplished simply by connecting the instrument, selecting the desired set point and alarm values, and turning on SMART Tuning. Just follow these easy steps:

1) Install the Phoenix P130 in the panel and connect wiring according to diagram. Apply power.

2) Select the set point and alarm values (if any). The parameter code will appear in the lower display, and the parameter value or status will be shown in the upper display.

Press the FUNC button. "SP" (set point) will appear. Use the ▲ or ▼ buttons to reach the desired set point value*.

Press FUNC again to scroll past "nnn" (the Safety Lock status).

If no Alarm has been selected, proceed to step 3 now. To set the Alarm threshold, continue below.

"AL" will appear next if an Alarm has been ordered. Use ▲ or ▼ to set the desired Alarm value. Press FUNC, and "hSA" (Alarm Hysteresis) will appear. Use ▲ or ▼ to enter the Hysteresis value*, if desired, then press FUNC.

3) When finished, do not press any buttons for 30 seconds. The instrument will then exit Operating Parameter mode and begin process control.

## OPERATING PARAMETERS

For those who wish to manually enter the PID parameters or program the control outputs, following is a complete list of the Operating Parameters, described in the order in which they appear.

To enter the Operating Parameter mode, press FUNC and release. When setting the Operating Parameter values, the lower display will show the parameter name, and the upper display will indicate the value of the parameter or whether it is ON or OFF. Use the ▲ or ▼ keys to select the desired value or ON/OFF status. To enter the value or status and move to the next parameter, press the FUNC button. When finished, wait 30 seconds for the instrument to return to control mode.

NOTE: Some of the following parameters may be skipped, depending on the instrument configuration. Factory default values, if any, are listed in ( ) parentheses.

**SP** Set point, expressed in engineering units. *

**nnn** Safety Lock parameter protection. On indicates that the parameters are locked, except for set point and manual reset. OFF indicates that the parameters are unlocked. To change the ON/OFF status, enter the password 853. *Available only when Password Protection has been selected.*

**AL** Alarm Threshold, expressed in engineering units. This is the value at which the Alarm will be activated.

**hSA** Alarm Hysteresis, expressed as a percentage of the configured input range span, from 0.1% to 10.0%. Active when process is coming out of alarm condition. *

**Pb** Proportional Band, expressed as a percentage of the configured input range span, from 1.0 to 99.9. The Phoenix PID tuning logic operates within this band to adjust the output until the temperature just reaches the desired set point. (4.0) *

**hS** Hysteresis for ON/OFF control action only, expressed as a percentage of the configured input range span, from 0.1% to 10.0%. *

**ti** Integral Time, expressed in minutes and seconds. Programmable from 1.20 to 20.0. This represents the time required to reset the Proportional Band in order to bring the temperature exactly to the set point. (4.0)

**td** Derivative Time, expressed in minutes and seconds. Programmable from 0.01 to 9.59. This represents the rate required to overcome deadband and shift the Proportional Band in order to compensate for a sudden change in process temperature. (1.00)

**C** OUTPUT 1 (Heating) Cycle Time, in seconds. This is the amount of time required for one output power on and off cycle for OUTPUT 1. Programmable from 1 to 200 seconds. (20)

**C2** OUTPUT 2 (Cooling) Cycle Time, in seconds. This is the amount of time required for one output power on and off cycle for OUTPUT 2. Programmable from 1 to 200 seconds. (10)

**rC** Relative Cooling Gain, in minutes and seconds from 0.20 to 1.00. This is the relative gain for OUTPUT 2 when used as a Cooling Output. (1.00)

**OLP** Deadband or Overlap between the Heating and Cooling Outputs, programmable from -20% to +50% of the Proportional Band. (0)

**rL** Set point low limit, expressed in engineering units. (0) *

**rH** Set point high limit, expressed in engineering units. (400) *

**OLH** Output high limit, expressed in % of the output. Programmable from 0% to 100% of heating output. This limit is based on the amount of time OUTPUT 1 is ON vs. the Cycle 1 time. (100)

**tOL** Time duration of the output power limit, from 1 to 100 minutes. This is the amount of time OLH is active. When tOL = Infinite, OLH is always active. (Inf)

* *NOTE: To achieve optimum PID performance, the actual input range span is narrower than listed: T/C °F input = 600°; T/C °C = 500°; RTD °F = 600°; RTD °C = 500°. Hysteresis functions, Proportional Band, and Set Point limits are determined by this span. If this configured input range span is too narrow for one or more of these desired parameter settings, contact Simpson Technical Support for adjustment instructions.*

## Operation cont.

### NORMAL DISPLAY MODE

In normal display mode, the upper display of the Phoenix indicates the measured value, while the lower display shows the set point value.

### DIRECT ACCESS TO SET POINT

It is possible to change the set point without going through the entire Operating Parameter selection.

Make sure the Phoenix is in normal display mode (no parameters are being modified). Press ▲ or ▼ and hold for at least three seconds. The set point value in the lower display will begin changing.

Press ▲ or ▼ until the desired set point value is reached. This new set point value will take effect after a three-second delay with no buttons being pressed.

NOTE: To cancel Direct Access, press FUNC. The instrument will revert to normal display mode and retain the original set point.

### OUTPUT POWER OFF FUNCTION

The Phoenix P130 can be operated as an indicator by turning off the control output power. To disable the output power, make sure the instrument is in normal display mode, then press ▲ and FUNC simultaneously for at least three seconds.

The P130 will now function as an indicator. "OFF" will appear in the lower display. Alarms, if any, will be in non-alarm condition.

To restore the control output power, press ▲ and FUNC simultaneously for at least three seconds.

### INSTRUMENT FAILURE INDICATOR

This feature allows the Phoenix P130 to detect measurement errors. In the case of an out-of-range or burnout condition, or an internal measurement error, the ALM LED indicator on the front panel will be lit.

### ERROR MESSAGES

The Phoenix PID controller performs self-diagnostic testing and indicates on the display any errors detected.

**Overrange: 000**
**Underrange: _00**
**Burnout Conditions:** will be shown as an overrange condition.

#### Coded Messages

When other errors are detected, **"Err"** appears in the lower display and the corresponding error code (e.g. "100," "200") shows in the upper display.

**NOTE:** Contact Simpson Technical Support at (708) 697-2260 for instructions on how to correct the error condition or to return the instrument for repair.

### CONFIGURATION

The configuration parameters of this instrument have been programmed according to the part number ordered. If the original application changes, the instrument can be reconfigured by Simpson or by an authorized Phoenix modification center. Call Technical Support at (708) 697-2260 for more details.

## Safety Symbols

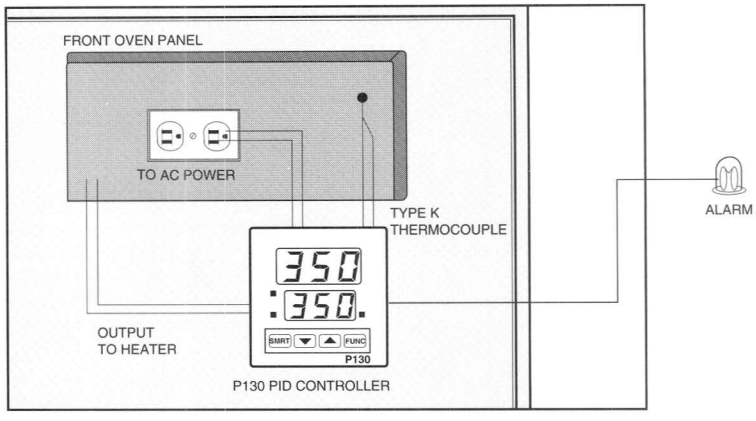
WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

**CAUTION**

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all the instrument.

## Application Example #1




A process engineer needs to install a temperature controller in an oven for a food processing plant. The controller needs to maintain the oven temperature at 350°F. An alarm must sound if the temperature exceeds 380°F. In addition, the engineer wants to include password protection and set point limits, so that the set point may be modified only by qualified plant personnel.

A Phoenix P130-0-8-0-1-1-1 will satisfy these requirements: Type K T/C input with a range of 0 to 999°F, relay with reverse action for heating on Output 1, process alarm for Output 2, high alarm for the alarm operating mode, and password protection to prohibit accidental tampering with the process.

The Phoenix is connected according to the wiring diagram, then FUNC is pressed to enter the Operating Parameter selection mode.

"SP" is set at 350 (°F), the desired set point temperature. "nnn" should display OFF, indicating that Safety Lock is inactive, to set the remaining parameters.

"AL" (the alarm threshold) appears next and is set at 380 (°F), the temperature above which the alarm is to be activated. "hSA" can be left at 0.1%; the temperature must then drop below 380°F by 0.1% of the configured input range span before the alarm is deactivated, eliminating "chatter" in the alarm relay should the measured value bounce around the alarm threshold. Pre-configured alarm masking prohibits the alarm from being tripped during start-up until the temperature has reached the set point.

"Pb", "ti", and "td" can be left at the values displayed, as SMART Tuning will automatically adjust these parameters.

"C" is set at 15, indicating that one output on and off cycle for the main output lasts for 15 seconds.

"rL" and "rH" limit the range in which the set point can be set. Entering 340 for "rL" and 360 for "rH" will make sure that, should someone accidentally access the set point, it cannot be set below 340°F or above 360°F.

"OLH" and "tOL"can be left at the values displayed. In this application, there is no need for a gradual approach to the set point.

At this point, press FUNC again until "nnn" appears in the lower display. Change "nnn" to On to activate Safety Lock.

After waiting for 30 seconds, the P130 will exit Operating Parameter selection mode and SMART tuning begins.

## Application Example #2

A lab technician needs to replace the controller in the lab's environmental chamber. The new controller must be able to maintain the temperature in the chamber at 10°C and trigger an alarm if the temperature rises above 25°C. The control output needs to be a solid state relay contact, and the controller must accept an RTD Pt100 signal input. In addition, the technician wants password protection to limit access to the operating parameters.

A Phoenix P130-0-5-3-1-1-1 will fulfill the technician's requirements: RTD Pt100 input with a range of -19.9 to +99.9 °C, SSR contact with direct action for cooling on Output 1, process alarm for Output 2, high alarm for the alarm operating mode, and Safety Lock "On" to restrict access to set point only without the password.

The Phoenix is connected according to the wiring diagram, then FUNC is pressed to enter the Operating Parameter selection mode.

"SP", the set point temperature, is set at 10.0 (°C). "nnn" should display OFF, indicating that Safety Lock is inactive, to set the remaining parameters.

"AL" (the alarm threshold) is set at 25 (°C), the temperature above which the alarm is to be activated. "hSA" (hysteresis) should be left at 0.1%; the temperature then must drop below 10.0 by 0.1% of the configured input range span before deactivating the alarm, eliminating "chatter" in the alarm relay should the measured value bounce around the alarm threshold.

"Pb", "ti", and "td" can be left at the values displayed. SMART Tuning will automatically adjust these parameters.

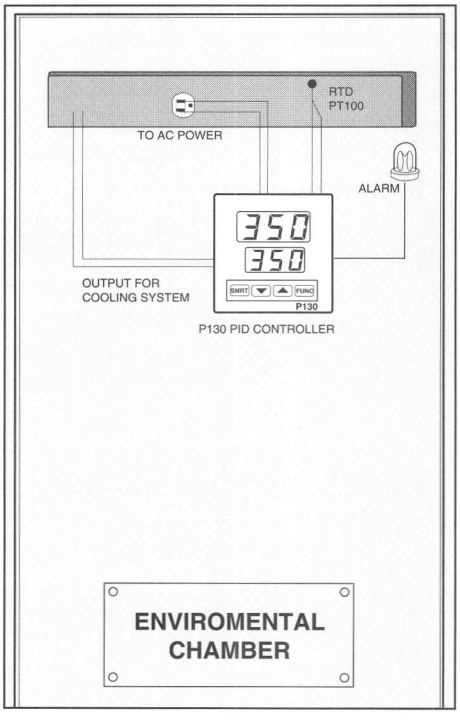
"C" is set at 20, indicating that one cooling output on and off cycle lasts for 20 seconds.

Entering 8.0 for "rL" and 12.0 for "rH" protects the process by limiting the selection range for the set point value. Should the set point be changed, the new value must be between 8.0°C and 12.0°C.

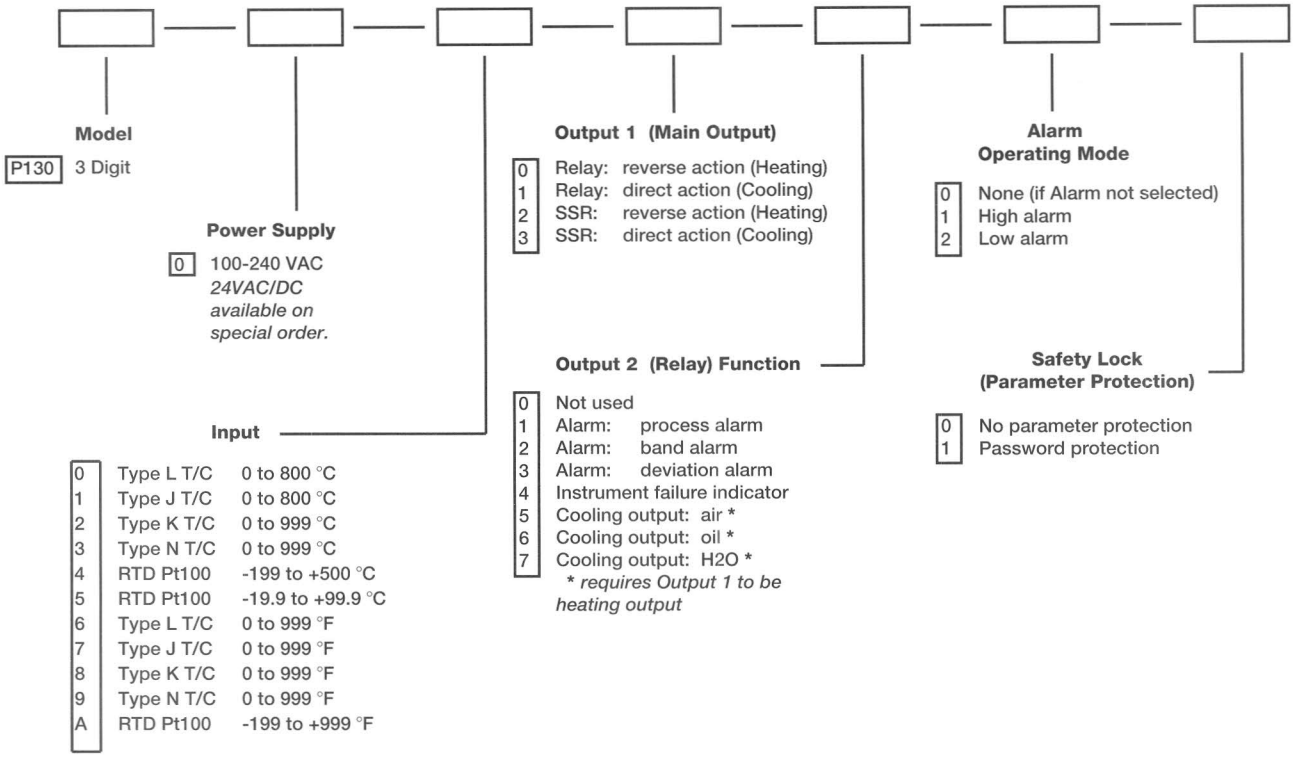
"OLH" and "tOL" can be left at the values displayed. A gradual approach to the set point is not needed in this application.

At this point, press FUNC again until "nnn" appears in the lower display. Set "nnn" to On to activate Safety Lock.

After waiting for 30 seconds, the P130 will exit Operating Parameter selection mode and SMART Tuning begins.



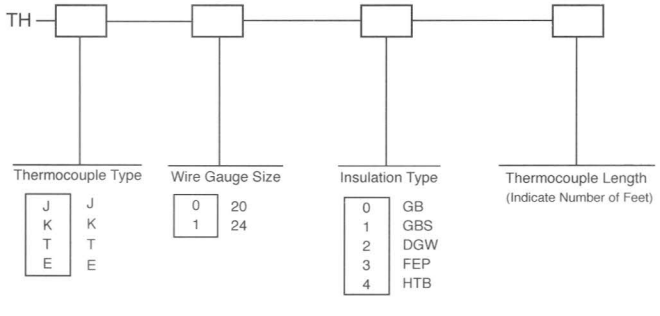
## Ordering Information




## Accessories

Simpson thermocouples are available in custom lengths per your application. Calibration type, wire gauge, insulation type, and length are determined by your specs, and entered into the following ordering diagram.

**Thermocouple Ordering Information**
**(Termination End: HJ-Beaded, CJ-Solid Bare Wire)**




**THERMOCOUPLE PROBES (QUICK DISCONNECT)**
Simpson offers "Quick Disconnect" style thermocouples which include a probe and an ANSI color coded jack and plug. Each 12 inch thermocouple probe is compacted with MgO insulation, with 316 stainless steel and 0.188 inch diameter outer sheath. Extra plugs and jacks are sold separately. See the table below for ordering information.

**THERMOCOUPLE PROBES (48 INCH LEAD WIRE)**
Simpson's transition joint thermocouple probes are constructed with MgO insulation. The probe includes 48" of Teflon® coated thermocouple wire and stripped leads.

| Type | Catalog Numbers | | | | |
|---|---|---|---|---|---|
| | ANSI Color Code | Quick Disconnect | 48 Inch Lead Wire | Plug Only | Jack Only |
| J | Black | 21238 | 21242 | 21245 | 21249 |
| K | Yellow | 21239 | 21243 | 21246 | 21250 |
| T | Blue | 21240 | ------ | 21247 | 21251 |
| E | Purple | 21241 | ------ | 21248 | 21252 |
| RTD | ------ | ------ | 21244 | ------ | ------ |

# Temperature Controllers

## Phoenix P140 PID Controller
## 4 Digit 1/16 DIN

- *Easily Programmed From the Front Panel*
- *SMART Auto-tuning for Automatic Adjustment and Continuous Tuning of Optimum Control Parameters*
- *Full PID or On/Off Control*
- *Dual Display: Both Measurement and Set Point Values*
- *Choice of T/C, RTD or Linear inputs (J, K, L, N, R, S, RTD Pt100, mA, mV, or V)*
- *Up to 2 Independent Alarms With Choice of Process, Band, or Deviation Alarms*
- *Automatic or Manual Reset of Alarm Condition*
- *Standard Screw Terminal Connector With Safety Cover*
- *Optional Heater Break Detection*

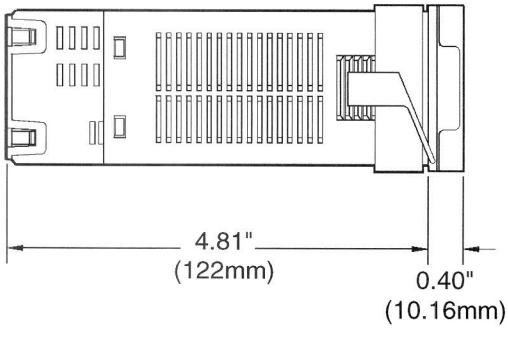

Simpson's new Phoenix Series PID controllers offer ease of use and full PID control for a variety of thermocouple, RTD, or linear inputs. The controller can operate in the standard PID control mode for both heating and cooling, with on-demand SMART Tuning to automatically set the optimum PID parameters. The P, I, and D actions are also manually adjustable over a wide range. On/Off control operation is keypad-selectable.

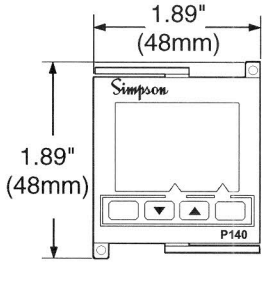
Two outputs are standard on the P140, allowing for both heating and cooling control. Up to two alarms are available and can be configured as process, band, or deviation alarms with automatic or manual reset. The safety lock feature provides password protection.

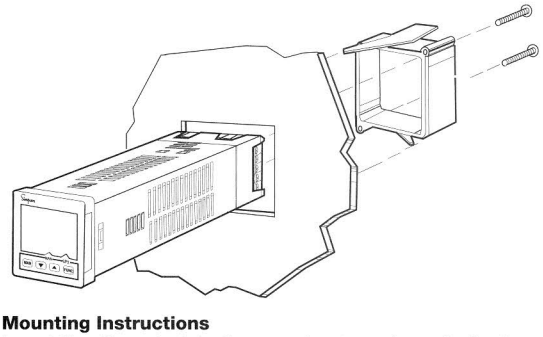
Model P140 features a dual, 4-digit LED display with LED indicators for output and alarm status. Screw terminal connectors are standard for easy wiring, and a rear safety cover is included.

The model P140 fits the standard 1/16 DIN panel cutout (45mm X 45mm) and requires only 122mm depth behind the panel. The front panel offers IP65/Nema 4X protection.

## Installation and Panel Cutout



**Mounting Instructions**
Insert the Phoenix into the panel cutout through the front. From behind the panel, slide the white mounting bracket over the Phoenix, gently pulling the tabs out to move the bracket. The mounting screws and tabs should be on the top and bottom of the controller. Push the bracket forward until it is flush with the panel, then tighten the mounting screws to hold the Phoenix in place.

## Specifications

**DISPLAY**
**Type:** Dual 4-digit LED
Upper (yellow-green): Process measurement value
Lower (orange): Set point value

**POWER REQUIREMENTS**
**AC Voltages:** 100 to 240 VAC +10/ -15%, 50/60 Hz
**Power Consumption:** 8 VA max.

**ACCURACY @ 25°C**
±0.2% of full scale

**ENVIRONMENTAL**
**Operating Temperature:** 0 to 50°C
**Storage Temperature:** -20 to 70°C
**Relative Humidity:** 20 to 85% non-condensing
**Warm-up Time:** None required

**NOISE REJECTION**
**NMRR:** 60 dB, 50/60 Hz
**CMRR:** 120 dB, 50/60 Hz

**ANALOG TO DIGITAL CONVERSION**
**Technique:** Dual slope integration
**Sampling Time:** 250ms (Linear inputs) 500ms (T/C and RTD inputs)

**INPUT: THERMOCOUPLE**
**Types:** J, K, L, N, R, S (either °C or °F)
**Cold Junction Compensation:** automatic from 0 to 50°C ambient temp.
**Input Impedance:** > 1 MΩ
**Resolution:** 0.1° or 1° C; 1°F

**INPUT: RTD** (.00385 alpha)
**Type:** Pt100 3-wire (either °C or °F)
**Line Resistance:** Max 20Ω/wire with no appreciable error
**Resolution:** 0.1° or 1° C; 0.1° or 1° F

**INPUT: LINEAR (mA, mV, V)**

| Input | Impedance |
|---|---|
| 0-20 mA | < 5 Ω |
| 4-20 mA | < 5 Ω |
| 0-60 mV | > 1 MΩ |
| 12-60 mV | > 1 MΩ |
| 0-5 V | > 200 kΩ |
| 1-5 V | > 200 kΩ |
| 0-10 V | > 400 kΩ |
| 2-10 V | > 400 kΩ |

**MECHANICAL**
**Bezel:** 1.9" x 1.9" (48 x 48 mm)
**Depth:** 4.8" (122mm)
**Panel Cut-out:** 1.8" x 1.8" (45 x 45mm 1/16 DIN)
**Case Material:** grey ABS
**Front Panel:** IP65, Nema 4X protection in accordance with CEI 70-1 req.

**Weight:** 0.5 lb (250 g) max.

**CONTROL CHARACTERISTICS**
**Control Method:** PID with SMART Tune for Auto and Adaptive tuning, or ON/OFF. Choose ON/OFF Control by setting Proportional Band = 0
**Proportional Band:** Programmable
For 1 control output: from 1.0% to 100.0% of the configured input span
For 2 control outputs: from 1.5% to 100.0% of the configured input span
**Integral Time:** Programmable from 20 seconds to 20 minutes, or excluded
**Integral Pre-load:** Programmable
For 1 control output: from 0% to 100% of the output range
For 2 control outputs: from -100% to +100% of the heating/cooling output range
**Derivative Time:** Programmable from 1 second to 10 minutes, or excluded
**Output 1 (Heating) Cycle Time:** Programmable from 1 to 200 seconds
**Hysteresis (for ON/OFF control):** Programmable from 0.1% to 10.0% of the configured input span

**In the Case of 2 Control Outputs:**
**Relative Cooling Gain:**
Programmable from 0.20 to 1.00
**Cooling cycle time:** Programmable from 1 to 200 seconds
**Overlap/deadband:** Programmable from -20% (deadband) to +50% (overlap) of the proportional band
NOTE: These Output 2 parameters will be automatically set during configuration according to the cooling medium (air, oil, or water) selected.

**Auto/Manual Mode:** Selectable from front panel
**Auto/Manual Transfer:** Bumpless method

**CONTROL OUTPUTS**
**Type:** One (Heating or Cooling) or Two (#1 Heating, #2 Cooling)
**Direct/Reverse Action:** Programmable
**Output Status Indication:** Red LED indicators (OUT 1, OUT 2, OUT 3) on the front panel are lit when their respective output is in the ON condition
**Output Level Limiter:**
Programmable. Operates at start-up for programmed time to avoid thermal shock.
For 1 control output: from 0% to 100% of the output span
For 2 control outputs: from -100% to +100% of the Output 1 (Heating) span

**Relay Outputs:**
**Output cycle time:** Programmable from 1 to 99 seconds
**Output 1 (Heating):** 3 Amp, 250 VAC SPDT contact
**Output 2 (Cooling):** 2 Amp, 250 VAC SPST contact

**Logic Voltage for SSR Driver (Output 1 only):**
**Logic Level 0:** Vout < 0.5 VDC
**Logic Level 1:**
14 VDC ± 20% @ 17 mA max.
24 VDC ± 20% @ 1 mA max.
**Output Safety Value:** When the instrument detects an out-of-range or a burn-out condition, it can force the output to a programmed safety value

**OUTPUT POWER OFF FUNCTION**
This function allows the instrument to operate as an indicator by disabling the control output, removing power from the controlled load. It is therefore possible to continue monitoring the process variable even if the load is off.

**ALARMS**
Alarm 1 may be selected in lieu of Output 2. An Alarm 2 is available as an option.
**Alarm Functions:** Process alarm, Band alarm, or Deviation alarm
**Alarm Reset:** Either Automatic or Manual reset
**Masking:** Each Alarm can be configured as masked, to avoid false alarm indication at start-up or after a set point change
**Alarm Indication:** LED indicators are lit when the respective alarm is ON
**Alarm Output:** 2 Amp, 250 VAC SPST contact
**Operational Mode:** Programmable
Process: high or low
Band: outside or inside band
Deviation: high or low
**Threshold:** Programmable
Process: in engineering units within the entire range
Band: from 0 to +500 units
Deviation: from -500 to +500 units
**Hysteresis:** Programmable from 0.1% to 10.0% of the configured input span

## Control Action

**ON / OFF CONTROL**

This is the simplest form of temperature control. An ON/OFF controller switches the output when the temperature crosses the set point. For heating applications, the output is ON (at 100%) below the set point and OFF (at 0%) above the set point; the opposite is true for cooling applications.

If the ON and OFF points were actually the same, the relay would cycle rapidly as the process temperature crossed the set point. To prevent this "chatter," a deadband, or Hysteresis, is added to the control operation. This Hysteresis sets a band around the set point that the temperature must cross before the output can be switched on or off again, eliminating rapid cycling.

The Phoenix can be configured for ON/OFF control by entering the Operation Parameter mode and setting the Proportional Band (Pb) = 0.

**PID CONTROL**

PID Control adds Proportional, Integral and Derivative action to ON/OFF Control in order to more closely regulate the process temperature. It is recommended for processes subject to wide temperature cycling or sudden changes in process temperature or load.

**Proportional Action** adjusts the output as soon as the process temperature enters a selected **Proportional Band** around the set point. The output is controlled proportionally to the difference between the set point and the actual process temperature. As the measured value approaches the set point, the output level gradually decreases until the temperature stabilizes.

In reality, Proportional Action usually brings the process temperature very close but not exactly to the set point. This difference is called "offset".

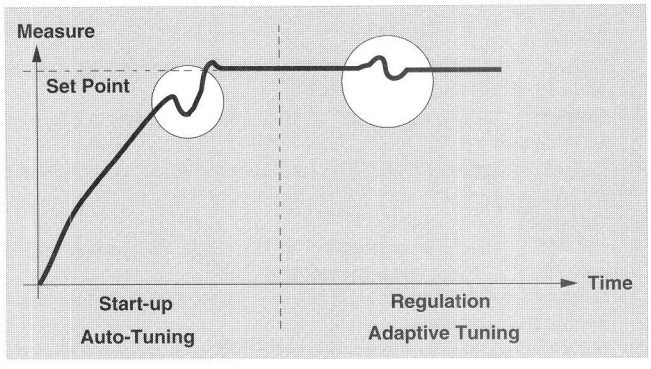
**Integral Action** automatically corrects this offset by measuring the difference between the set point and the measured value and then shifting the Proportional Band accordingly. Integral Action is expressed in minutes and seconds, representing the time needed to reset the Proportional Band. For this reason, Integral Action is often referred to as "reset".

**Derivative Action** enables the controller to react to rapid changes in the process temperature -- for example, a sudden rush of cooler material into the flow. The output is adjusted in proportion to the rate of change in the process temperature over the set derivative time. Derivative Action is therefore often referred to as "rate".

With the Simpson Phoenix PID controller, the PID values can be selected by the user in the Operation parameter setting mode. However, SMART Tuning will monitor the process and automatically set the optimum PID parameters.

## SMART Tuning

Simpson's Phoenix PID controller is equipped with a SMART self-tuning algorithm. SMART Tuning enables the controller to automatically adjust the PID parameters to the optimum levels according to the process conditions.




**At Start-Up**

SMART implements auto-tuning function to calculate optimum PID values for best approach to set point.

**During Regulation**

SMART continually monitors the process and updates the PID parameters as the Phoenix adapts to changes in either set point or load.

To enable SMART Tuning, press FUNC until the "Snrt" parameter appears in the lower display. Press ▲ or ▼ until the upper display reads On, and press FUNC again to enter. The SMART LED indicator will be flashing during auto-tuning and lit during continuous adaptive tuning.

NOTE: While the SMART Tuning function is enabled, the control parameters (Pb, ti, td) may be displayed but not modified.

To disable SMART Tuning, press FUNC until the "Snrt" parameter appears in the lower display. Press ▲ or ▼ until the upper display reads OFF, and press FUNC again to enter. The SMART LED indicator will turn off.

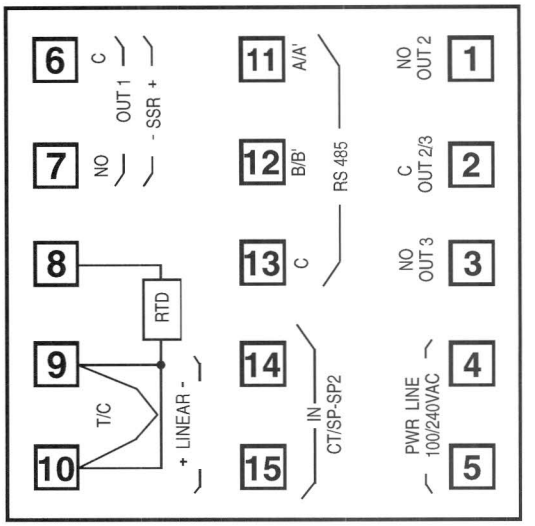
## Soft Start

Simpson's Phoenix PID controller is equipped with a Soft Start function to gradually warm up the process temperature. Soft Start takes effect immediately at start-up, limiting the output power level in order to avoid thermal shock.

Output during Soft Start is determined according to the Output High Limit (OLH) and Output 1 Cycle Time (CY1) operating parameters. OLH sets the percentage of the CY1 time that the output power will be ON during Soft Start. For example, if CY1 = 15 seconds and OLH was set at 50%, then the heating output would only be ON for a maximum of 7.5 seconds during Soft Start.

## Wiring Diagram

**Supply Power:** Connect the power (100-240 VAC) to terminals #4 and #5.
**Input Signal:**
Thermocouples are connected to terminals #9 and #10.
RTDs are connected to terminals #8, #9, and #10.
Linear (mA, mV, V) inputs are connected to terminals #9 (IN LO) and #10 (IN HI).
**Outputs:**
Output 1 (main Heating or Cooling output) is connected to terminals #6 (+ for SSR) and #7 (- for SSR).
Output 2 (Cooling output or Alarm output) is connected to terminals #1 (NO) and #2 (C).
Output 3 (Optional Alarm 2 output) is connected to terminals #2 (C) and #3 (NO).
**Options:**
RS 485 interface is connected to terminals #11 (A/A'), #12 (B/B'), and #13 (C). *(Not presently offered)*
Current Transformer for Heater Break Detection is connected to terminals #14 and #15.
Input for Auxiliary Set Point is connected to terminals #14 and #15.




**WARNING**

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

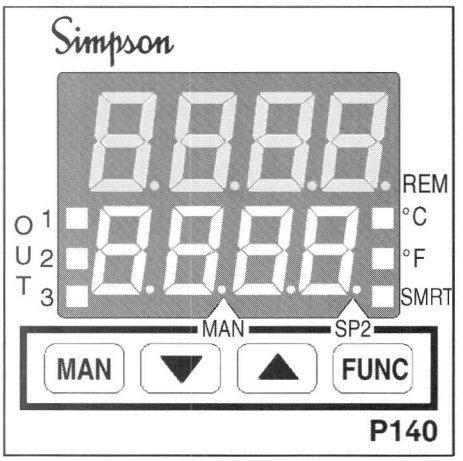
**CAUTION**

The Solid State Relay option (SSR) is a logic voltage for a SSR driver. Be sure to connect to a SSR driver and not directly to the load.

**CAUTION**

Before switching the instrument on, make sure the supply voltage is within the range required as indicated on the hook-up label affixed to the instrument.

## P140 Display




**DISPLAY**
**Upper Display:** Process measurement value (yellow-green)
**Lower Display:** Set point value (orange)

**KEYPAD DESCRIPTION**

▼ Decreases the selected parameter value.

▲ Increases the selected parameter value.

FUNC Displays parameters in sequence and enters new values. Also displays output level and heater current.

MAN Switches from Auto to Manual mode.

▲ + FUNC Enables/Disables the OUTPUT POWER OFF function.

**LED INDICATORS**

**REM** The decimal point at the right end of the upper display flashes to indicate that the instrument is being operated via serial link. *(Not presently offered)*

**SP2** The decimal point at the right end of the lower display flashes slowly when Auxiliary Set Point is used and flashes rapidly when a set point from the serial link is used.

**SMRT** Indicates SMART Tuning function is active. Flashes during auto-tuning. Lit during adaptive tuning.

**MAN** The decimal point second from the left in the lower display flashes when the instrument is in Manual mode.

**°C / °F** Indicates the selected engineering unit (for thermocouple and RTD inputs).

**OUT 1** Indicates OUTPUT 1 (Main Output) is ON.

**OUT 2** Indicates OUTPUT 2 is ON, if Cooling Output is selected, OR
Indicates ALARM 1 is ON, if Alarm 1 is selected.

**OUT 3** Indicates ALARM 2 is ON (steady light), OR
Flashes slowly when heater current is lower than the programmed HBD threshold, OR
Flashes rapidly when ALARM 2 and HBD are both active.

# Operation

## SIMPLE SET-UP

Starting PID Control can be accomplished simply by connecting the instrument, selecting the desired set point and alarm values, and turning on SMART Tuning. Just follow these easy steps:

1) Install the Phoenix P140 in the panel and connect wiring according to diagram. Apply power.

2) Select the set point and alarm values (if any). The parameter code will appear in the lower display, and the parameter value or status will be shown in the upper display.

Press the FUNC button. "SP" (set point) will appear. Use the ▲ or ▼ buttons to reach the desired set point value*. Press FUNC again.

"Snrt" (for SMART Tuning) will then appear. Press ▲ or ▼ to switch SMART to On, then press FUNC.

Press FUNC again to scroll past "n.RST" and once more past "nnn".

"SP2" will appear next if the Auxiliary Set Point option has been ordered. Use ▲ or ▼ to select the desired second set point value*. Press FUNC.

"AL1" will appear if Alarm 1 has been ordered. Use ▲ or ▼ to set the desired Alarm 1 value. Press FUNC, and "HSA1" (Alarm 1 Hysteresis) will appear. Use ▲ or ▼ to enter the Hysteresis value*, if desired, then press FUNC. If Alarm 2 has been ordered, "AL2" will appear next. Follow the steps for AL1 to set the Alarm 2 and Hysteresis values*.

3) When finished, do not press any buttons for 30 seconds. The instrument will then exit Operating Parameter mode and begin process control.

## OPERATING PARAMETERS

For those who wish to manually enter the PID parameters or program the control outputs, following is a complete list of the Operating Parameters, described in the order in which they appear.

To enter the Operating Parameter mode, press FUNC and release. When setting the Operating Parameter values, the lower display will show the parameter name, and the upper display will indicate the value of the parameter or whether it is ON or OFF. Use the ▲ or ▼ keys to select the desired value or ON/OFF status. To enter the value or status and move to the next parameter, press the FUNC button. When finished, wait 30 seconds for the instrument to return to control mode.

NOTE: Some of the following parameters may be skipped, depending on the instrument configuration. Factory default values are listed in ( ) parentheses.

**SP** Set point, expressed in engineering units. (Minimum range value) *

**Snrt** SMART Tuning function status. Setting this status to On enables the SMART function. Setting it to OFF disables the SMART function.

**n.RSt** Manual Reset of Alarms. If Manual Reset has been ordered for the alarms, set to On to reset the alarms. (OFF)

**nnn** Safety Lock parameter protection. On indicates that the parameters are locked, except for set point and manual reset. OFF indicates that the parameters are unlocked. To change the ON/OFF status, enter the password 853. (OFF)
*Available only when Password Protection has been selected.*

**SP2** Auxiliary set point, expressed in engineering units. (Minimum range value) *

**AL1** Alarm 1 Threshold, expressed in engineering units. This is the value at which Alarm 1 will be activated. (Process alarm: minimum range value. Band/Deviation alarm: 0)

**HSA1** Alarm 1 Hysteresis, expressed as a percentage of the configured input range span. (0.1%) *

**AL2** Alarm 2 Threshold, expressed in engineering units. This is the value at which Alarm 2 will be activated. (Process alarm: minimum range value. Band/Deviation alarm: 0)

**HSA2** Alarm 2 Hysteresis, expressed as a percentage of the configured input range span. (0.1%) *

**Pb** Proportional Band, expressed as a percentage of the configured input range span. The Phoenix PID tuning logic operates within this band to adjust the output until the temperature just reaches the desired set point. (4.0%) *

**hYS** Hysteresis for ON/OFF control action only, expressed as a percentage of the configured input range span. (0.5%) *

**ti** Integral Time, expressed in minutes and seconds as "mm.ss". This represents the time required to reset the Proportional Band in order to bring the temperature exactly to the set point. (4.00)

**td** Derivative Time, expressed in minutes and seconds as "mm.ss". This represents the rate required to overcome deadband and shift the Proportional Band in order to compensate for a sudden change in process temperature. (1.00)

**CY1** OUTPUT 1 Cycle Time, in seconds. This is the amount of time required for one output power on and off cycle for OUTPUT 1. (15 sec. for Relay output, 4 sec. for SSR output)

**CY2** OUTPUT 2 Cycle Time, in seconds. This is the amount of time required for one output power on and off cycle for OUTPUT 2. (10 sec. for Air as cooling medium, 4 sec. for Oil, 2 sec. for H20)

**rC** Relative Cooling Gain, in minutes and seconds. This is the relative gain for OUTPUT 2 when used as a Cooling Output. (1.00 for Air as cooling medium, 0.80 for Oil, 0.40 for H20)

**OLAP** Deadband or Overlap between the Heating and Cooling Outputs, expressed as a percentage of the Proportional Band. (0%)

**rL** Set point low limit, expressed in engineering units. (Initial scale value) *

**rH** Set point high limit, expressed in engineering units. (Full scale value) *

**Grd1** Ramp applied to a positive set point change, expressed in digits per minute. This is the rate at which the process will ramp up to a new, higher set point. (Infinite)

**Grd2** Ramp applied to a negative set point change, expressed in digits per minute. This is the rate at which the process will ramp down to a new, lower set point. (Infinite)

**OLH** Output high limit, expressed in % of the output. This limit is based on the amount of time OUTPUT 1 is ON vs. the Cycle 1 time. (100%)

**tOL** Time duration of the output power limit, in minutes. This is the amount of time OLH is active. When tOL = Infinite, OLH is always active. (Infinite)

**Hbd** Threshold value for Heater Break Detection alarm, in Amperes. (50% of current transformer range)

* *NOTE: To achieve optimum PID performance, the actual input range span is narrower than listed: T/C °F input = 600°; T/C °C = 500°; RTD °F = 600°; RTD °C = 500°. (Linear input span is set by the user.) Hysteresis functions, Proportional Band, and Set Point limits are determined by this span. If this configured input range span is too narrow for one or more of these desired parameter settings, contact Simpson Technical Support for adjustment instructions.*

## Operation cont.

### DISPLAY FUNCTION

In normal display mode, the upper display indicates the measured value, while the lower display shows the set point value.

The lower display can be used to show other information as follows:

1) Press the FUNC button and hold for three seconds. If Heater Break Detection (HBD) has been selected, the lower display will show "A." followed by the OUTPUT 1 current level as measured by the HBD current transformer.

2) Press FUNC again. The lower display will now show "H." followed by the OUTPUT 1 power value, expressed from 0 to 100 %. This represents the time OUTPUT 1 is ON vs. the Cycle Time.

3) If OUTPUT 2 has been selected as a Cooling Output, press FUNC again. The lower display will show "C." followed by the OUTPUT 2 power value.

4) Press FUNC again to return to normal display mode.

NOTE: Failure to press a button within 30 seconds will cause the display to return to normal display mode. To keep one of the above values on the lower display, press ▲ or ▼ to cancel the timer function. When ready to return to normal display mode, simply press FUNC again.

### DIRECT ACCESS TO SET POINT

It is possible to change the set point without going through the entire Operating Parameter selection.

Make sure the Phoenix is in Auto Mode and normal display mode (no parameters are being modified). Press ▲ or ▼ and hold for two seconds. The set point value in the lower display will begin changing.

Press ▲ or ▼ until the desired set point value is reached. This new set point value will take effect after a two-second delay with no buttons being pressed.

### MANUAL MODE

The output power levels can be manually adjusted in Manual Mode. When the Phoenix is operating in normal display mode, the Manual Mode function can be accessed by pressing MAN for more than one second. The decimal point in the middle of the lower display will flash to indicate that the instrument is in Manual Mode.

The OUTPUT 1 power output value is shown (in %) in the two most significant digits of the lower display. The OUTPUT 2 % value, if any, appears in the two least significant digits. These output values can be modified by pressing ▲ or ▼.

To return to Auto Mode, press MAN again for more than one second. The transfer between Auto and Manual Mode is bumpless.

NOTE: If the instrument is turned off while in Manual Mode, it will revert to Auto Mode PID control when powered up again.

### OUTPUT POWER OFF FUNCTION

The Phoenix P140 can be operated as an indicator by turning off the control output power. To disable the output power, make sure the instrument is in normal display mode, then press ▲ and FUNC simultaneously for 5 seconds.

The P140 will now function as an indicator. "OFF" will appear in the lower display. Alarms, if any, will be in non-alarm condition.

To restore the control output power, press ▲ and FUNC simultaneously for 5 seconds.

### ERROR MESSAGES

The Phoenix PID controller performs self-diagnostic testing and indicates on the display any errors detected.

**Overrange: 0000**
**Underrange: _000**
**Sensor Lead Break:**
T/C, RTD, mV: Overrange
mA, V: Underrange

#### Coded Messages

When other errors are detected, **"Err"** appears in the lower display and the corresponding error code (e.g. "100," "200") shows in the upper display.

**NOTE:** Contact Simpson Technical Support at (708) 697-2260 for instructions on how to correct the error condition or to return the instrument for repair.

### CONFIGURATION

The configuration parameters of this instrument have been programmed according to the part number ordered. If the original application changes, the instrument can be reconfigured by Simpson or by an authorized Phoenix modification center. Call Technical Support at (708) 697-2260 for more details.

## Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all the instrument.

## Options

### HEATER BREAK DETECTION

An optional alarm is available on the Phoenix to monitor the OUTPUT 1 (Heating) load current. The Heater Break Detection (HBD) function measures the current flowing through the power line of the equipment being controlled by OUTPUT 1. If the current level drops below the pre-determined HBD threshold value, the alarm is triggered and the OUT 3 LED indicator will flash.

The sampling of the load current will occur only if the power output has been applied to the load for at least 50ms.

NOTE: A current transformer with 50 mA AC secondary is required for the Heater Break Detection option. For ordering information, see the Accessories section on the last page.

### AUXILIARY SET POINT

An optional logic input provides a second set point on the Phoenix. This auxiliary set point is useful in applications that call for a different temperature to be maintained during non-working hours, or for processes where the material may be changed, eliminating the need for a separate controller.

Transfer from the main set point (SP) to the auxiliary set point (SP2) and vice-versa is driven by logic input (contact closure). The transfer may be done via ramp or via step transfer.

NOTE: The operating set point (SP or SP2) must be selected by external contact, at terminals #14 and #15. For this reason, the Auxiliary Set Point option may not be used in conjunction with Heater Break Detection.

## Application Example

An instrument engineer at a plastics molding company needs a temperature controller to maintain the temperature in the blow molder at 425°F. Overshoot is a concern, because the plastic may burn if the temperature exceeds 435°F, so an alarm needs to be activated at 435°F and remain on until manually reset. Another alarm needs to be activated if the temperature drops below 375°F.

A Phoenix P140-0-L-0-1-3-1-4-0-1 will satisfy these requirements: Type J T/C input with a range of 0 to 1830°F, relay with reverse action for heating on Output 1, process alarm 1 for Output 2, high alarm with manual reset for the alarm operating mode, process alarm 2 as low alarm with manual reset, and safety lock to prohibit access to parameters without entering a password.

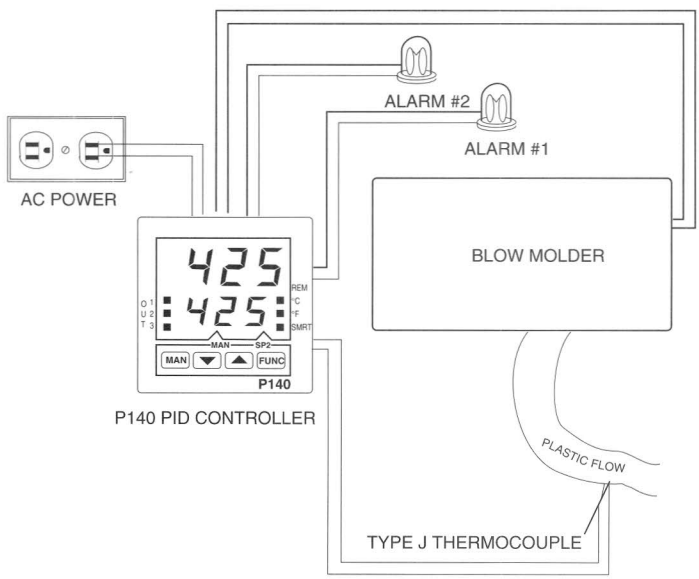
The P140's Soft Start function will reduce the risk of overshoot by regulating the approach to the set point temperature. The heating output will only be on for a percentage of each output on and off cycle, causing the temperature to rise at a slower pace.

The Phoenix is connected according to the wiring diagram, then FUNC is pressed to enter the Operating Parameter selection mode.

"SP" is set at 425 (°F), the desired set point temperature. "Snrt" is changed to On, to enable SMART Tuning.

"n.Rst" should display OFF, as the alarm has not been reset, and "nnn" should display OFF, indicating that Safety Lock is inactive, to set the remaining parameters.

"AL1" is the next parameter to appear and is set at 435 (°F), the temperature at which the alarm is to be activated. "HSA1" can be left at 0.1%; the temperature must then drop below 435°F by 0.1% of the configured input range span before the alarm is deactivated, eliminating "chatter" in the alarm relay should the measured value bounce around the alarm threshold. "AL2," the low alarm, is set at 375 (°F) and "HSA2" at 0.1%. Pre-configured alarm masking prohibits the alarms from being tripped during start-up until the temperature has reached the set point.




"Pb," "ti," and "td" can be left at the values displayed, as SMART Tuning will automatically adjust these parameters.

"CY1" is set at 15, indicating that one output on and off cycle for the main output lasts for 15 seconds. The next parameter to adjust is "OLH", which is set at 50. The main output will then be on for 50% of each 15-second cycle during Soft Start, allowing the plastic to warm up gradually to 425°F.

At this point, press FUNC again until "nnn" appears in the lower display. Change "nnn" to On to activate Safety Lock.

After waiting for 30 seconds, the P140 will exit Operating Parameter selection mode and SMART Tuning begins.

# Ordering Information

**Model**

P140 4 Digit

**Power Supply**

0 100-240 VAC

**Input**

| | | |
|---|---|---|
| 0 | Type L T/C | 0 to 400.0 °C |
| 1 | Type L T/C | 0 to 900 °C |
| 2 | Type J T/C | 0 to 400.0 °C |
| 3 | Type J T/C | 0 to 1000 °C |
| 4 | Type K T/C | 0 to 400.0 °C |
| 5 | Type K T/C | 0 to 1200 °C |
| 6 | Type N T/C | 0 to 1400 °C |
| 7 | Type R T/C | 0 to 1760 °C |
| 8 | Type S T/C | 0 to 1760 °C |
| 9 | RTD Pt100 | -199.9 to +400.0 °C |
| A | RTD Pt100 | -200 to +800 °C |
| B | mV | 0 to 60 mV |
| C | mV | 12 to 60 mV |
| D | mA | 0 to 20 mA |
| E | mA | 4 to 20 mA |
| F | V | 0 to 5 V |
| G | V | 1 to 5 V |
| H | V | 0 to 10 V |
| J | V | 2 to 10 V |
| K | Type L T/C | 0 to 1650 °F |
| L | Type J T/C | 0 to 1830 °F |
| M | Type K T/C | 0 to 2190 °F |
| N | Type N T/C | 0 to 2550 °F |
| P | Type R T/C | 0 to 3200 °F |
| Q | Type S T/C | 0 to 3200 °F |
| R | RTD Pt100 | -199.9 to +400.0 °F |
| S | RTD Pt100 | -330 to +1470 °F |

**Output 1 (Main Output)**

| | |
|---|---|
| 0 | Relay: reverse action (Heating) |
| 1 | Relay: direct action (Cooling) |
| 2 | SSR: reverse action (Heating) |
| 3 | SSR: direct action (Cooling) |

**Output 2 (Relay)**

| | |
|---|---|
| 0 | Not used |
| 1 | Alarm 1: process alarm |
| 2 | Alarm 1: band alarm |
| 3 | Alarm 1: deviation alarm |
| 4 | Cooling output: air * |
| 5 | Cooling output: oil * |
| 6 | Cooling output: H2O * |

** requires Output 1 to be heating output*

**Alarm 1 Operating Mode**

| | |
|---|---|
| 0 | None (if Alarm 1 not selected) |
| 1 | High alarm: automatic reset |
| 2 | Low alarm: automatic reset |
| 3 | High alarm: manual reset |
| 4 | Low alarm: manual reset |

**Options**

| | |
|---|---|
| 0 | None |
| 1 | Alarm 2: process alarm |
| 2 | Alarm 2: band alarm |
| 3 | Alarm 2: deviation alarm |
| 4 | Heater Break Detection + Alarm 2: process alarm |
| 5 | Heater Break Detection + Alarm 2: band alarm |
| 6 | Heater Break Detection + Alarm 2: deviation alarm |
| 7 | Auxiliary Set Point + Alarm 2: process alarm |
| 8 | Auxiliary Set Point + Alarm 2: band alarm |
| 9 | Auxiliary Set Point + Alarm 2: deviation alarm |

**Alarm 2 Operating Mode**

| | |
|---|---|
| 0 | None (if Alarm 2 not selected) |
| 1 | High alarm: automatic reset |
| 2 | Low alarm: automatic reset |
| 3 | High alarm: manual reset |
| 4 | Low alarm: manual reset |

**Primary Current for Transformer**

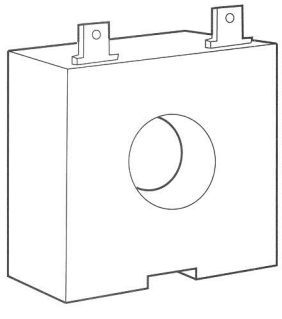
| | |
|---|---|
| 0 | None (if Heater Break Detection not selected) |
| 1 | 10 Amp AC |
| 2 | 25 Amp AC |
| 3 | 50 Amp AC |
| 4 | 100 Amp AC |

*NOTE: Current Transformers sold separately.*

**Safety Lock (Parameter Protection)**

| | |
|---|---|
| 0 | No parameter protection |
| 1 | Password protection |

# Accessories



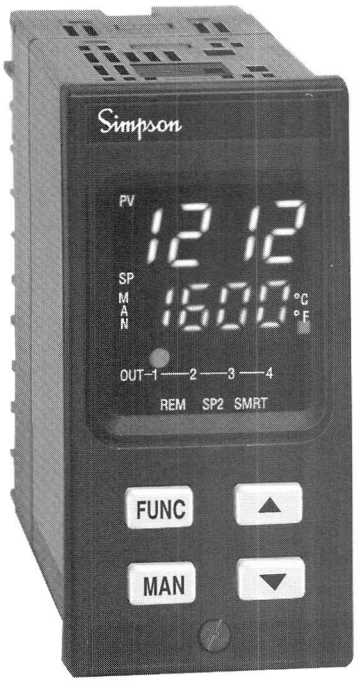
The PCTR series Current Transformer should be ordered for Phoenix PID controllers with the Heater Break Detection option. This Current Transformer measures the Output 1 current and sends a signal to the Phoenix if that load current drops below the pre-programmed threshold. Spade terminals permit easy connection. Leads are not included.

| Catalog Number | Primary (ACA) | Secondary (ACmA) | Accuracy@ 0.2VA Pmax |
|---|---|---|---|
| PCTR10 | 10 | 50 | 2.3 % |
| PCTR25 | 25 | 50 | 2.0 % |
| PCTR50 | 50 | 50 | 1.0 % |
| PCTR100 | 100 | 50 | 1.0 % |
| **Nominal Operating Frequency:** 50 to 60Hz | | | |

NOTE: Thermocouples and Temperature Transmitters compatible with the Phoenix PID controllers are also available from Simpson. Contact factory for more information.

# Temperature Controllers

## Phoenix P240 PID Controller
## 4 Digit 1/8 DIN




- *Easily Programmed From the Front Panel*
- *SMART Auto-tuning for Automatic Adjustment and Continuous Tuning of Optimum Control Parameters*
- *Full PID or On/Off Control*
- *Dual Display: Both Measurement and Set Point Values*
- *Choice of T/C, RTD or Linear inputs (J, K, L, N, R, S, RTD Pt100, mA, mV, or V)*
- *Up to 3 Independent Alarms With Choice of Process, Band, or Deviation Alarms and Automatic or Manual Reset*
- *Optional Heater Break Detection*
- *Standard Screw Terminal Connector With Safety Cover*
- *Auxiliary Set Point Standard*

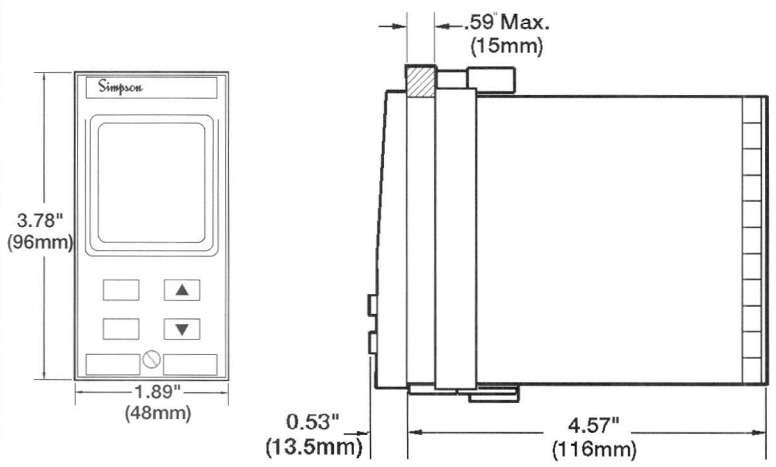
Simpson's new Phoenix Series PID controllers offer ease of use and full PID control for a variety of thermocouple, RTD, or linear inputs. The controller can operate in the standard PID control mode for both heating and cooling, with on-demand SMART Tuning to automatically set the optimum PID parameters. The P, I, and D actions are also manually adjustable over a wide range. On/Off control operation is keypad-selectable.

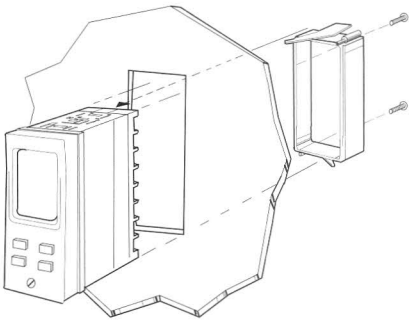
Three outputs are standard on the P240, allowing for both heating and cooling control. Up to three alarms are available and can be configured as process, band, or deviation alarms with automatic or manual reset. The safety lock feature provides password protection.

Model P240 features a dual, 4-digit LED display with LED indicators for output and alarm status. Screw terminal connectors are standard for easy wiring, and a rear safety cover is included.

The model P240 fits the standard vertical 1/8 DIN panel cutout (45mm X 92mm) and requires only 116mm depth behind the panel. The front panel offers IP65/Nema 4X protection.

## Installation and Panel Cutout



**Mounting Instructions**
Insert the Phoenix into the panel cutout through the front. From behind the panel, slide the white mounting bracket over the Phoenix, gently pulling the tabs out to move the bracket. The mounting screws and tabs should be on the top and bottom of the controller. Push the bracket forward until it is flush with the panel, then tighten the mounting screws to hold the Phoenix in place.

## Specifications

**DISPLAY**
**Type:** Dual 4-digit LED
Upper (yellow-green): Process measurement value
Lower (orange): Set point value

**POWER REQUIREMENTS**
**AC Voltages:** 100 to 240 VAC ±10%, 50/60 Hz OR 24 VAC +10/-15%
**DC Voltages:** 24 VDC +10/-15%
*NOTE: 24V AC/DC is available on special order.*
**Power Consumption:** 8 VA

**ACCURACY @ 25°C**
+0.2% of full scale

**ENVIRONMENTAL**
**Operating Temperature:** 0 to 50°C
**Storage Temperature:** -20 to 70°C
**Relative Humidity:** 20 to 85% non-condensing
**Warm-up Time:** None required

**NOISE REJECTION**
**NMRR:** 60 dB, 50/60 Hz
**CMRR:** 120 dB, 50/60 Hz

**ANALOG TO DIGITAL CONVERSION**
**Technique:** Dual slope integration
**Sampling Time:** 250ms (Linear inputs) 500ms (T/C and RTD inputs)

**INPUT: THERMOCOUPLE**
**Types:** J, K, L, N, R, S (either °C or °F)
**Cold Junction Compensation:** automatic from 0 to 50°C ambient temp.
Error: 0.1°C/°C
**Input Impedance:** > 1 MΩ
**Resolution:** 0.1° or 1° C; 1° F

**INPUT: RTD** (.00385 alpha)
**Type:** Pt100 3-wire (either °C or °F)
**Line Resistance:** Max 20Ω/wire with no appreciable error
**Resolution:** 0.1° or 1° C; 0.1 or 1° F

**INPUT: LINEAR (mA, mV, V)**

| Input | Impedance |
|---|---|
| 0-20 mA | < 5 Ω |
| 4-20 mA | < 5 Ω |
| 0-60 mV | > 1 MΩ |
| 12-60 mV | > 1 MΩ |
| 0-5 V | > 200 kΩ |
| 1-5 V | > 200 kΩ |
| 0-10 V | > 400 kΩ |
| 2-10 V | > 400 kΩ |

**MECHANICAL**
**Bezel:** 1.9" x 3.8" (48 x 96 mm)
**Depth:** 4.57" (116 mm)
**Panel Cutout:** 1.8" x 3.6" (45 x 92mm 1/8 DIN)
**Case Material:** black ABS
**Front Panel:** IP65, Nema 4X protection in accordance with CEI 70-1 req.
**Weight:** 0.8 lb (400 g) max.

**CONTROL CHARACTERISTICS**
**Control Method:** PID with SMART Tune for Auto and Adaptive tuning, or ON/OFF. Choose ON/OFF Control by setting Proportional Band = 0
**Proportional Band:** Programmable
For 1 control output: from 1.0% to 100.0% of the configured input span
For 2 control outputs: from 1.5% to 100.0% of the configured input span
**Integral Time:** Programmable from 20 seconds to 20 minutes, or excluded
**Integral Pre-load:** Programmable
For 1 control output: from 0% to 100% of the output range
For 2 control outputs: from -100% to +100% of the heating/cooling output range
**Derivative Time:** Programmable from 1 second to 10 minutes, or excluded
**Output 1 (Heating) Cycle Time:** Programmable from 1 to 200 seconds
**Hysteresis (for ON/OFF control):** Programmable from 0.1% to 10.0% of the configured input span

**In the Case of 2 Control Outputs:**
**Relative Cooling Gain:** Programmable from 0.20 to 1.00
**Cooling cycle time:** Programmable from 1 to 200 seconds
**Overlap/deadband:** Programmable from -20% (deadband) to +50% (overlap) of the proportional band
NOTE: These Output 2 parameters will be automatically set during configuration according to the cooling medium (air, oil, or water) selected.

**Auto/Manual Mode:** Selectable from front panel
**Auto/Manual Transfer:** Bumpless method

**CONTROL OUTPUTS**
**Type:** One (Heating or Cooling) or Two (#1 Heating, #2 Cooling)
**Direct/Reverse Action:** Programmable
**Output Status Indication:** Red LED indicators (OUT 1, OUT 2) on the front panel are lit when their respective output is in the ON condition
**Output Level Limiter:** Programmable
Operates at start-up for programmed time to avoid thermal shock.
For 1 control output: from 0% to 100% of the output span
For 2 control outputs: from -100% to +100% of the Output 1 (Heating) span

**Relay Outputs:**
**Output cycle time:** Programmable from 1 to 99 seconds
**Output 1 (Heating):** 3 Amp, 250 VAC SPDT contact
**Output 2 (Cooling):** 2 Amp, 250 VAC SPST contact

**Logic Voltage for SSR Driver (Output 1 only):**
**Logic Level 0:** Vout < 0.5 VDC
**Logic Level 1:**
14 VDC ± 20% @ 17 mA max.
24 VDC ± 20% @ 1 mA max.
**Output Safety Value:** When the instrument detects an out-of-range or a burn-out condition, it can force the output to a programmed safety value.

**OUTPUT POWER OFF FUNCTION**
This function allows the instrument to operate as an indicator by disabling the control output, removing power from the controlled load. It is therefore possible to continue monitoring the process variable even if the load is off.

**ALARMS**
Alarm 1 may be selected in lieu of Output 2 and Alarm 2 in lieu of Output 3. An Alarm 3 is available as an option.
**Alarm Functions:** Process alarm, Band alarm, or Deviation alarm
**Alarm Reset:** Either Automatic or Manual reset
**Masking:** Each Alarm can be configured as masked, to avoid false alarm indication at start-up or after a set point change
**Alarm Indication:** LED indicators are lit when the respective alarm is ON
**Alarm Output:** 2 Amp, 250 VAC SPST contact
**Operational Mode:** Programmable
Process: high or low
Band: outside or inside band
Deviation: high or low
**Threshold:** Programmable
Process: in engineering units within the entire range
Band: from 0 to +500 units
Deviation: from -500 to +500 units
**Hysteresis:** Programmable from 0.1% to 10.0% of the configured input span

## Control Action

**ON / OFF CONTROL**

This is the simplest form of temperature control. An ON/OFF controller switches the output when the temperature crosses the set point. For heating applications, the output is ON (at 100%) below the set point and OFF (at 0%) above the set point; the opposite is true for cooling applications.

If the ON and OFF points were actually the same, the relay would cycle rapidly as the process temperature crossed the set point. To prevent this "chatter," a deadband, or Hysteresis, is added to the control operation. This Hysteresis sets a band around the set point that the temperature must cross before the output can be switched on or off again, eliminating rapid cycling.

The Phoenix can be configured for ON/OFF control by entering the Operation Parameter mode and setting the Proportional Band (Pb) = 0.

**PID CONTROL**

PID Control adds Proportional, Integral and Derivative action to ON/OFF Control in order to more closely regulate the process temperature. It is recommended for processes subject to wide temperature cycling or sudden changes in process temperature or load.

**Proportional Action** adjusts the output as soon as the process temperature enters a selected **Proportional Band** around the set point. The output is controlled proportionally to the difference between the set point and the actual process temperature. As the measured value approaches the set point, the output level gradually decreases until the temperature stabilizes.

In reality, Proportional Action usually brings the process temperature very close but not exactly to the set point. This difference is called "offset".

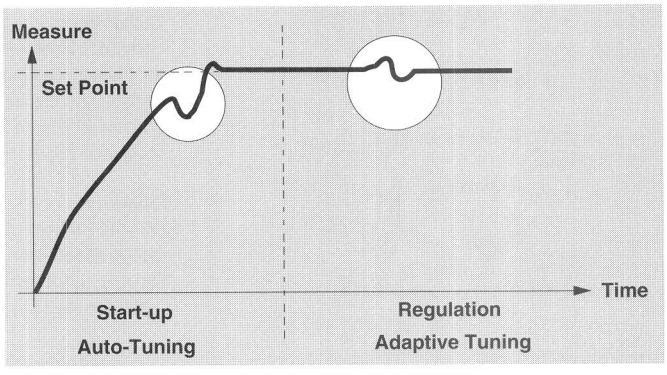
**Integral Action** automatically corrects this offset by measuring the difference between the set point and the measured value and then shifting the Proportional Band accordingly. Integral Action is expressed in minutes and seconds, representing the time needed to reset the Proportional Band. For this reason, Integral Action is often referred to as "reset".

**Derivative Action** enables the controller to react to rapid changes in the process temperature -- for example, a sudden rush of cooler material into the flow. The output is adjusted in proportion to the rate of change in the process temperature over the set derivative time. Derivative Action is therefore often referred to as "rate".

With the Simpson Phoenix PID controller, the PID values can be selected by the user in the Operation parameter setting mode. However, SMART Tuning will monitor the process and automatically set the optimum PID parameters.

## SMART Tuning

Simpson's Phoenix PID controller is equipped with a SMART self-tuning algorithm. SMART Tuning enables the controller to automatically adjust the PID parameters to the optimum levels according to the process conditions.




**At Start-Up**

SMART implements auto-tuning function to calculate optimum PID values for best approach to set point.

**During Regulation**

SMART continually monitors the process and updates the PID parameters as the Phoenix adapts to changes in either set point or load.

To enable SMART Tuning, press FUNC until the "Snrt" parameter appears in the lower display. Press ▲ or ▼ until the upper display reads On, and press FUNC again to enter. The SMART LED indicator will be flashing during auto-tuning and lit during continuous adaptive tuning.

NOTE: While the SMART Tuning function is enabled, the control parameters (Pb, ti, td) may be displayed but not modified.

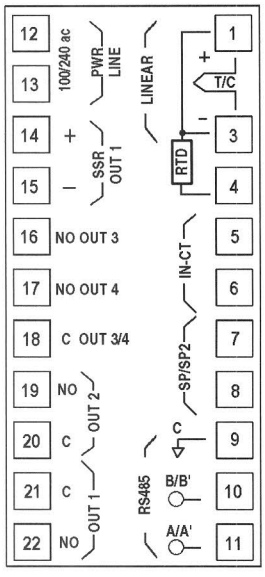
To disable SMART Tuning, press FUNC until the "Snrt" parameter appears in the lower display. Press ▲ or ▼ until the upper display reads OFF, and press FUNC again to enter. The SMART LED indicator will turn off.

## Soft Start

Simpson's Phoenix PID controller is equipped with a Soft Start function to gradually warm up the process temperature. Soft Start takes effect immediately at start-up, limiting the output power level in order to avoid thermal shock.

Output during Soft Start is determined according to the Output High Limit (OLH) and Output 1 Cycle Time (CY1) operating parameters. OLH sets the percentage of the CY1 time that the output power will be ON during Soft Start. For example, if CY1 = 15 seconds and OLH was set at 50%, then the heating output would only be ON for a maximum of 7.5 seconds during Soft Start.

## Wiring Diagram




**Supply Power:** Connect the power (100-240 VAC) to terminals #12 and #13.

**Input Signal:**
Thermocouples are connected to terminals #1 and #3.
RTDs are connected to terminals #1, #3, and #4.
Linear (mA, mV, V) inputs are connected to terminals #1 (IN HI) and #3 (IN LO).

**Outputs:**
Output 1 (main Heating or Cooling output) is connected to terminals #21 (C) and #22 (NO) for Relay; #14 (+) and #15 (-) for SSR.
Output 2 (Cooling output or Alarm output) is connected to terminals #19 (NO) and #20 (C).
Output 3 (Alarm 2 output) is connected to terminals #16 (NO) and #18 (C).
Output 4 (Optional Alarm 3 output) is connected to terminals #17 (NO) and #18 (C).

**Options:**
RS 485 interface is connected to terminals #11 (A/A'), #10 (B/B'), and #9 (C). *(Not presently offered)*
Current Transformer for Heater Break Detection is connected to terminals #5 and #6.
Input for Auxiliary Set Point is connected to terminals #7 and #8.

**CAUTION**

The Solid State Relay option (SSR) is a logic voltage for a SSR driver. Be sure to connect to a SSR driver and not directly to the load.

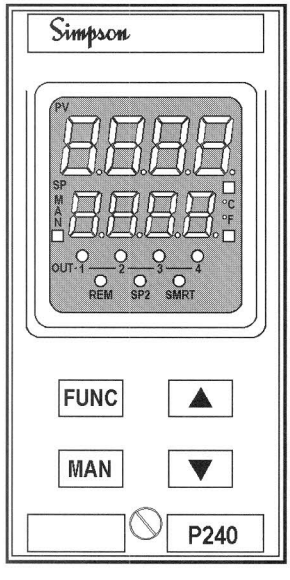
**CAUTION**

Before switching the instrument on, make sure the supply voltage is within the range required as indicated on the hook-up label affixed to the instrument.

**WARNING**

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

## P240 Display




**KEYPAD DESCRIPTION**

▼ Decreases the selected parameter value.

▲ Increases the selected parameter value.

FUNC Displays parameters in sequence and enters new values. Also displays output level and heater current.

MAN Switches from Auto to Manual mode.

▲ + FUNC Enables/Disables the OUTPUT POWER OFF function.

**DISPLAY**

**Upper Display:** Process measurement value (yellow-green)

**Lower Display:** Set point value (orange)

**LED INDICATORS**

**MAN** Lit when the instrument is in Manual mode.

**°C / °F** Indicates the selected engineering unit.

**OUT 1** Lit when OUTPUT 1 (Main Output) is ON.

**OUT 2** Lit when OUTPUT 2 is ON, if Cooling Output is selected, OR
when ALARM 1 is ON, if Alarm 1 is selected.

**OUT 3** Lit when ALARM 2 is ON, OR
Flashes slowly when Heater Break Detection is active, OR
Flashes rapidly when ALARM 2 and HBD are both active.

**OUT 4** Lit when Alarm 3 is ON.

**REM** Indicates that the instrument is being operated via serial link. *(Not presently offered)*

**SP2** Lit when Auxiliary Set Point is used and flashes when a set point from the serial link is used.

**SMRT** Indicates SMART Tuning function is active. Flashes during auto-tuning. Lit during adaptive tuning.

# Operation

## SIMPLE SET-UP

Starting PID Control can be accomplished simply by connecting the instrument, selecting the desired set point and alarm values, and turning on SMART Tuning. Just follow these easy steps:

1) Install the Phoenix P240 in the panel and connect wiring according to diagram. Apply power.

2) Select the set point and alarm values (if any). The parameter code will appear in the lower display, and the parameter value or status will be shown in the upper display.

Press the FUNC button. "SP" (set point) will appear. Use the ▲ or ▼ buttons to reach the desired set point value*. Press FUNC again.

"Snrt" (for SMART Tuning) will then appear. Press ▲ or ▼ to switch SMART to On, then press FUNC. Press FUNC again to scroll past "n.RST" and once more past "nnn".

"SP2" will appear next if the Auxiliary Set Point has been selected. Use ▲ or ▼ to select the desired second set point value*. Press FUNC.

"AL1" will appear if Alarm 1 has been chosen. Use ▲ or ▼ to set the desired Alarm 1 value. Press FUNC, and "HSA1" (Alarm 1 Hysteresis) will appear. Use ▲ or ▼ to enter the Hysteresis value*, if desired, then press FUNC. Repeat for AL2 and AL3 if ordered.

3) When finished, do not press any buttons for 30 seconds. The instrument will then exit Operating Parameter mode and begin process control.

## OPERATING PARAMETERS

For those who wish to manually enter the PID parameters or program the control outputs, following is a complete list of the Operating Parameters, described in the order in which they appear.

To enter the Operating Parameter mode, press FUNC and release. When setting the Operating Parameter values, the lower display will show the parameter name, and the upper display will indicate the value of the parameter or whether it is ON or OFF. Use the ▲ or ▼ keys to select the desired value or ON/OFF status. To enter and move to the next parameter, press the FUNC button. When finished, wait 30 seconds for the instrument to return to control mode.

NOTE: Some of the following parameters may be skipped, depending on the instrument configuration. Factory default values are listed in ( ) parentheses.

**SP** Set point, expressed in engineering units. (Minimum range value) *

**Snrt** SMART Tuning function status. Setting this status to On enables the SMART function. Setting it to OFF disables the SMART function.

**n.RSt** Manual Reset of Alarms. If Manual Reset has been ordered for the alarms, set to On to reset the alarms. (OFF)

**nnn** Safety Lock parameter protection. On indicates that the parameters are locked, except for set point and manual reset. OFF indicates that the parameters are unlocked. To change the ON/OFF status, enter the password 853. (OFF) *Available only when Password Protection has been selected.*

**SP2** Auxiliary set point, expressed in engineering units. (Minimum range value) *

**AL1** Alarm 1 Threshold, expressed in engineering units. This is the value at which Alarm 1 will be activated. (Process alarm: minimum range value. Band/Deviation alarm: 0)

**HSA1** Alarm 1 Hysteresis, expressed as a percentage of the configured input range span. (0.1%) *

**AL2** Alarm 2 Threshold, expressed in engineering units. This is the value at which Alarm 2 will be activated. (Process alarm: minimum range value. Band/Deviation alarm: 0)

**HSA2** Alarm 2 Hysteresis, expressed as a percentage of the configured input range span. (0.1%) *

**AL3** Alarm 3 Threshold, expressed in engineering units. This is the value at which Alarm 3 will be activated. (Process alarm: minimum range value. Band/Deviation alarm: 0)

**HSA3** Alarm 3 Hysteresis, expressed as a percentage of the configured input range span. (0.1%) *

**Pb** Proportional Band, expressed as a percentage of the configured input range span. The Phoenix PID tuning logic operates within this band to adjust the output until the temperature just reaches the desired set point. (4.0%) *

**hYS** Hysteresis for ON/OFF control action only, expressed as a percentage of the configured input range span. (0.5%) *

**ti** Integral Time, expressed in minutes and seconds as "mm.ss". This represents the time required to reset the Proportional Band in order to bring the temperature exactly to the set point. (4.00)

**td** Derivative Time, expressed in minutes and seconds as "mm.ss". This represents the rate required to overcome deadband and shift the Proportional Band in order to compensate for a sudden change in process temperature. (1.00)

**CY1** OUTPUT 1 Cycle Time, in seconds. This is the amount of time required for one output power on and off cycle for OUTPUT 1. (15 sec. for Relay output, 4 sec. for SSR output)

**CY2** OUTPUT 2 Cycle Time, in seconds. This is the amount of time required for one output power on and off cycle for OUTPUT 2. (10 sec. for Air as cooling medium, 4 sec. for Oil, 2 sec. for H20)

**rC** Relative Cooling Gain, in minutes and seconds. This is the relative gain for OUTPUT 2 when used as a Cooling Output. (1.00 for Air as cooling medium, 0.80 for Oil, 0.40 for H20)

**OLAP** Deadband or Overlap between the Heating and Cooling Outputs, expressed as a percentage of the Proportional Band. (0%)

**rL** Set point low limit, expressed in engineering units. (Initial scale value) *

**rH** Set point high limit, expressed in engineering units. (Full scale value)*

**Grd1** Ramp applied to a positive set point change, expressed in digits per minute. This is the rate at which the process will ramp up to a new, higher set point. (Infinite)

**Grd2** Ramp applied to a negative set point change, expressed in digits per minute. This is the rate at which the process will ramp down to a new, lower set point. (Infinite)

**OLH** Output high limit, expressed in % of the output. This limit is based on the amount of time OUTPUT 1 is ON vs. the Cycle 1 time. (100%)

**tOL** Time duration of the output power limit, in minutes. This is the amount of time OLH is active. When tOL = Infinite, OLH is always active. (Inf)

**Hbd** Threshold value for Heater Break Detection alarm, in Amperes. (50% of current transformer range)

* *NOTE: To achieve optimum PID performance, the actual input range span is narrower than listed: T/C °F input = 600°; T/C °C = 500°; RTD °F = 600°; RTD °C = 500°. (Linear input span is set by the user.) Hysteresis functions, Proportional Band, and Set Point limits are determined by this span. If this configured input range span is too narrow for one or more of these desired parameter settings, contact Simpson Technical Support for adjustment instructions.*

## Operation cont.

### DISPLAY FUNCTION

In normal display mode, the upper display indicates the measured value, while the lower display shows the set point value.

The lower display can be used to show other information as follows:

1) Press the FUNC button and hold for three seconds. If Heater Break Detection (HBD) has been selected, the lower display will show "A." followed by the OUTPUT 1 current level as measured by the HBD current transformer.

2) Press FUNC again. The lower display will now show "H." followed by the OUTPUT 1 power value, expressed from 0 to 100 %. This represents the time OUTPUT 1 is ON vs. the Cycle Time.

3) If OUTPUT 2 has been selected as a Cooling Output, press FUNC again. The lower display will show "C." followed by the OUTPUT 2 power value.

4) Press FUNC again to return to normal display mode.

NOTE: Failure to press a button within 30 seconds will cause the display to return to normal display mode. To keep one of the above values on the lower display, press ▲ or ▼ to cancel the timer function. When ready to return to normal display mode, simply press FUNC again.

### DIRECT ACCESS TO SET POINT

It is possible to change the set point without going through the entire Operating Parameter selection.

Make sure the Phoenix is in Auto Mode and normal display mode (no parameters are being modified). Press ▲ or ▼ and hold for two seconds. The set point value in the lower display will begin changing.

Press ▲ or ▼ until the desired set point value is reached. This new set point value will take effect after a two-second delay with no buttons being pressed.

### MANUAL MODE

The output power levels may be manually adjusted in Manual Mode. When the Phoenix is operating in normal display mode, the Manual Mode function can be accessed by pressing MAN for more than one second. The MAN LED indicator will flash to indicate that the instrument is in Manual Mode.

The OUTPUT 1 power output value is shown (in %) in the two most significant digits of the lower display. The OUTPUT 2 % value, if any, appears in the two least significant digits. These output values can be modified by pressing ▲ or ▼.

To return to Auto Mode, press MAN again for more than two seconds. The transfer between Auto and Manual Mode is bumpless.

NOTE: If the instrument is turned off while in Manual Mode, it will revert to Auto Mode PID control when powered up again.

### OUTPUT POWER OFF FUNCTION

The Phoenix P240 can be operated as an indicator by turning off the control output power. To disable the output power, make sure the instrument is in normal display mode, then press ▲ and FUNC simultaneously for 5 seconds.

The P240 will now function as an indicator. "OFF" will appear in the lower display. Alarms, if any, will be in non-alarm condition.

To restore the control output power, press ▲ and FUNC simultaneously for 5 seconds.

### ERROR MESSAGES

The Phoenix PID controller performs self-diagnostic testing and indicates on the display any errors detected.

**Overrange: 0000**
**Underrange: _000**
**Sensor Lead Break:**
T/C, RTD, mV: Overrange
mA, V: Underrange

#### Coded Messages

When other errors are detected, **"Err"** appears in the lower display and the corresponding error code (e.g. "100," "200") shows in the upper display.

**NOTE:** Contact Simpson Technical Support at (708) 697-2260 for instructions on how to correct the error condition or to return the instrument for repair.

### CONFIGURATION

The configuration parameters of this instrument have been programmed according to the part number ordered. If the original application changes, the instrument can be reconfigured by Simpson or by an authorized Phoenix modification center. Call Technical Support at (708) 697-2260 for more details.

## Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all the instrument.

## Options

### HEATER BREAK DETECTION

An optional alarm is available on the Phoenix to monitor the OUTPUT 1 (Heating) load current. The Heater Break Detection (HBD) function measures the current flowing through the power line of the equipment being controlled by OUTPUT 1. If the current level drops below the pre-determined HBD threshold value, the alarm is triggered and the OUT 3 LED indicator will flash.

The sampling of the load current will occur only if the power output has been applied to the load for at least 50ms.

NOTE: A current transformer with 50 mA AC secondary is required for the Heater Break Detection option. For ordering information, see the Accessories section on the last page.

### AUXILIARY SET POINT

A logic input provides a second set point on the Phoenix. This auxiliary set point is useful in applications that call for a different temperature to be maintained during non-working hours, or for processes where the material may be changed, eliminating the need for a separate controller.

Transfer from the main set point (SP) to the auxiliary set point (SP2) and vice-versa is driven by logic input (contact closure). The transfer may be done via ramp or via step transfer.

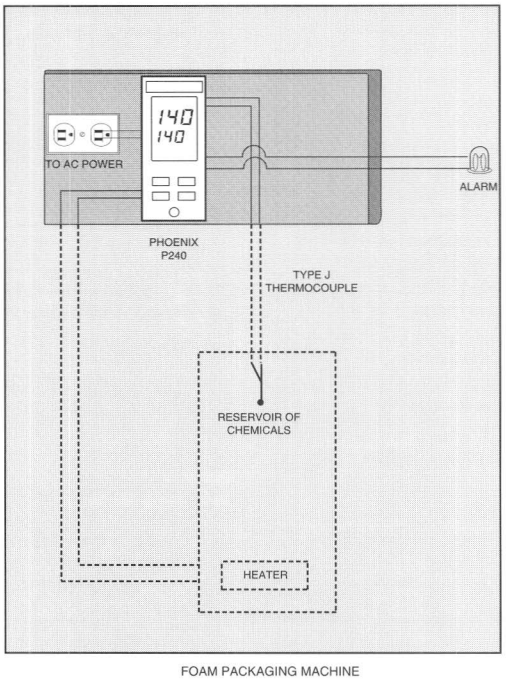
Auxiliary Set Point is standard on the P240. However, the operating set point (SP or SP2) must be selected by external contact, at terminals #7 and #8.

## Application Example

A design engineer needs a temperature controller for the company's proposed new foam packaging machine. The chemicals used to produce the foam must be heated to 140°F. The controller must also trigger an alarm if the temperature falls below 120°F or rises above 160°F. Safety Lock is desired so that the parameters cannot be changed without a password once the packaging machine is assembled and shipped.

A Phoenix P240-0-L-0-2-1-0-0-0-0-0-1 will satisfy the design engineer's requirements: Type J T/C input with a range of 0 to 1830°F, relay with reverse action for heating on Output 1, band alarm for Output 2, high (outside band) alarm for the alarm operating mode, and Safety Lock with Password Protection.

The Phoenix is connected according to the wiring diagram, then FUNC is pressed to enter the Operating Parameter selection mode.



FOAM PACKAGING MACHINE

"SP" is set at 140 (°F), the desired set point temperature. "Snrt" should be changed to On, to enable SMART Tuning. "nnn" should display OFF, indicating that Safety Lock is inactive, to set the remaining parameters.

"AL1," the alarm threshold level, is set at 20, creating a band of 20 degrees on either side of the 140°F set point. The alarm will then be triggered if the temperature falls outside of this band; i.e., below 120°F or above 160°F. "HSA1" can be left at 0.1%; the temperature must deviate outside either band limit by 0.1% of the configured input range span before the alarm is deactivated, eliminating "chatter" in the alarm relay should the measured temperature bounce around one of the band limits. Pre-configured alarm masking prohibits the alarm from being tripped during start-up until the temperature has reached the set point.

"Pb," "ti," and "td" can be left at the values displayed, as SMART Tuning will automatically adjust these parameters.

"CY1" is set at 15, indicating that one output on and off cycle for the heating output lasts for 15 seconds. The next parameter to adjust is "OLH, " which can be set at 50. This will limit the heating output to being on only 50% of each 15-second cycle during Soft Start, allowing the chemicals to warm up gradually to 140°F.

At this point, press FUNC again until "nnn" appears in the lower display. Set "nnn" to On to activate Safety Lock.

After waiting for 30 seconds, the P240 will exit Operating Parameter selection mode and SMART Tuning begins.

# Ordering Information

□ – □ – □ – □ – □ – □ – □ – □ – □ – □ – □ – □

**Model**

P240 4 Digit

**Power Supply**

0 100-240 VAC
*24V AC/DC available on special order*

**Input**

| | | |
|---|---|---|
| 0 | Type L T/C | 0 to 400.0 °C |
| 1 | Type L T/C | 0 to 900 °C |
| 2 | Type J T/C | 0 to 400.0 °C |
| 3 | Type J T/C | 0 to 1000 °C |
| 4 | Type K T/C | 0 to 400.0 °C |
| 5 | Type K T/C | 0 to 1200 °C |
| 6 | Type N T/C | 0 to 1400 °C |
| 7 | Type R T/C | 0 to 1760 °C |
| 8 | Type S T/C | 0 to 1760 °C |
| 9 | RTD Pt100 | -199.9 to +400.0 °C |
| A | RTD Pt100 | -200 to +800 °C |
| B | mV | 0 to 60 mV |
| C | mV | 12 to 60 mV |
| D | mA | 0 to 20 mA |
| E | mA | 4 to 20 mA |
| F | V | 0 to 5 V |
| G | V | 1 to 5 V |
| H | V | 0 to 10 V |
| J | V | 2 to 10 V |
| K | Type L T/C | 0 to 1650 °F |
| L | Type J T/C | 0 to 1830 °F |
| M | Type K T/C | 0 to 2190 °F |
| N | Type N T/C | 0 to 2550 °F |
| P | Type R T/C | 0 to 3200 °F |
| Q | Type S T/C | 0 to 3200 °F |
| R | RTD Pt100 | -199.9 to +400.0 °F |
| S | RTD Pt100 | -330 to +1470 °F |

**Output 1 (Main Output)**

| | |
|---|---|
| 0 | Relay: reverse action (Heating) |
| 1 | Relay: direct action (Cooling) |
| 2 | SSR: reverse action (Heating) |
| 3 | SSR: direct action (Cooling) |

**Output 2 (Relay)**

| | |
|---|---|
| 0 | Not used |
| 1 | Alarm 1: process alarm |
| 2 | Alarm 1: band alarm |
| 3 | Alarm 1: deviation alarm |
| 4 | Cooling output: air * |
| 5 | Cooling output: oil * |
| 6 | Cooling output: H2O * |

** requires Output 1 to be heating output*

**Alarm 1 Operating Mode**

| | |
|---|---|
| 0 | None (if Alarm 1 not selected) |
| 1 | High alarm: automatic reset |
| 2 | Low alarm: automatic reset |
| 3 | High alarm: manual reset |
| 4 | Low alarm: manual reset |

**Output 3 (Relay)**

| | |
|---|---|
| 0 | Not used |
| 1 | Alarm 2: process alarm |
| 2 | Alarm 2: band alarm |
| 3 | Alarm 2: deviation alarm |

**Alarm 2 Operating Mode**

| | |
|---|---|
| 0 | None (if Alarm 2 not selected) |
| 1 | High alarm: automatic reset |
| 2 | Low alarm: automatic reset |
| 3 | High alarm: manual reset |
| 4 | Low alarm: manual reset |

**Options**

| | |
|---|---|
| 0 | None |
| 1 | Heater Break Detection + Alarm 3: process alarm |
| 2 | Heater Break Detection + Alarm 3: band alarm |
| 3 | Heater Break Detection + Alarm 3: deviation alarm |

**Alarm 3 Operating Mode**

| | |
|---|---|
| 0 | None (if Alarm 3 not selected) |
| 1 | High alarm: automatic reset |
| 2 | Low alarm: automatic reset |
| 3 | High alarm: manual reset |
| 4 | Low alarm: manual reset |

**Primary Current for Transformer**

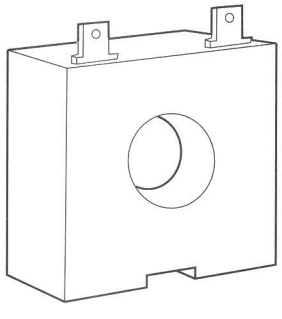
| | |
|---|---|
| 0 | None (if Heater Break Detection not selected) |
| 1 | 10 Amp AC |
| 2 | 25 Amp AC |
| 3 | 50 Amp AC |
| 4 | 100 Amp AC |

*NOTE: Current Transformer sold separately*

**Safety Lock (Parameter Protection)**

| | |
|---|---|
| 0 | No parameter protection |
| 1 | Password protection |

# Accessories



The PCTR series Current Transformer should be ordered for Phoenix PID controllers with the Heater Break Detection option. This Current Transformer measures the Output 1 current and sends a signal to the Phoenix if that load current drops below the pre-programmed threshold. Spade terminals permit easy connection. Leads are not included.

| Catalog Number | Primary (ACA) | Secondary (ACmA) | Accuracy@ 0.2VA Pmax |
|---|---|---|---|
| PCTR10 | 10 | 50 | 2.3 % |
| PCTR25 | 25 | 50 | 2.0 % |
| PCTR50 | 50 | 50 | 1.0 % |
| PCTR100 | 100 | 50 | 1.0 % |
| **Nominal Operating Frequency:** 50 to 60Hz | | | |

NOTE: Thermocouples and Temperature Transmitters compatible with the Phoenix PID controllers are also available from Simpson. Contact factory for more information.

# Temperature Controllers

## HAWK II

## Hawk II H235 Series
## 3-1/2 Digit On-Off Controllers

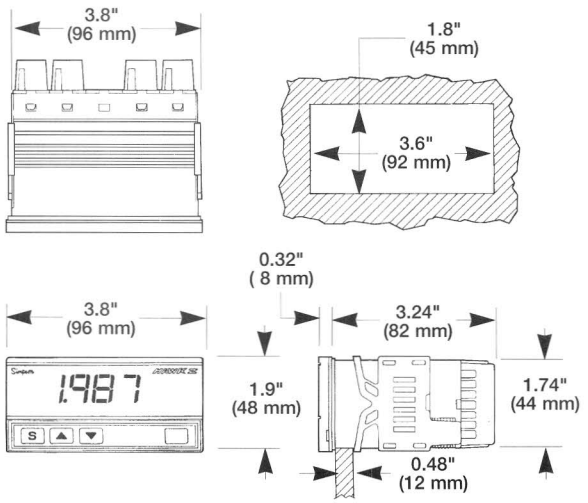
- ***Easily Programmed from the Front Panel***
- ***User Friendly Software Functions Include:***
  ***Password***
  ***Display either °F or °C***
  ***Decimal Point Selection***
  ***Zero, One, or Two Setpoints***
  ***Peak-Valley Values***
  ***Time Delay & Hysteresis***
- ***Screw Terminal Connector for Easy Installation***
- ***1/8 DIN, Shallow Depth Case,***
  ***3.5" (89mm) for Restricted Space Behind Panel***
- ***Nema 4 / IP 65 Front Panel***
- ***3 Temperature Options: J T/C, K T/C, RTD Pt 100 Ω***
- ***Optional 5 Amp Relay Outputs,***
  ***Excitation Outputs, and Analog Outputs***

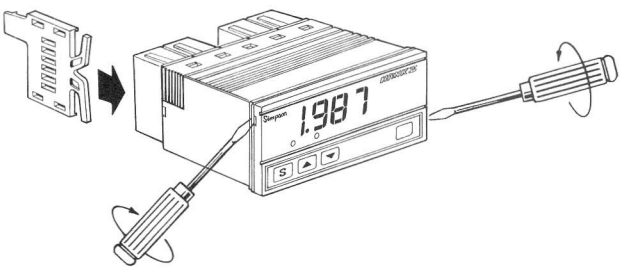

Simpson's Hawk II Microprocessor based Indicator/Controllers are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering units. Excitation outputs are available for external transmitters and transducers.

Two optional 5 Amp Relays include programming features for Hysteresis, Time Delay, and Relay operation. Optional Analog outputs are also available. Other programmable software features include programmable decimal point and a password lockout feature. Depending on the password value chosen, the customer may lock out all changes or merely those relating to setup, leaving the setpoint values accessible to the operator.

The Hawk II Series Indicator/ Controllers are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case with a depth of only 3.56" (90mm). The Hawk II has a Nema 4 / IP 65 rated front panel which equips the unit for wash down environments. Screw terminals are standard for easy installation.

## Installation and Panel Cutout




Insert the instrument into the panel and fasten it with the two brackets provided.

To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

## Specifications

**DISPLAY**
**Type:** 7 segment, red LED
**Height:** 0.56" (14.2mm)
**Decimal Point:** 3 position software programmable from front panel
**Overrange:** Display reads "EE"
**Underrange:** Display reads "-EE"
**Alarm Indicators:** Two LED indicators for alarm conditions on front panel

**POWER REQUIREMENTS**
**AC Voltages:** 24, 48, 115, 230 VAC, ±10%
**DC Voltages:** Future Availability
**Power Consumption:** 6 VA

**ENVIRONMENTAL**
**Operating Temperature:** 0°C to +50°C
**Storage Temperature:** -10°C to +60°C
**Relative Humidity:** <90% non-condensing
**Ambient Temperature:** 23°C
**Warmup Time:** 10 minutes

**NOISE REJECTION**
**NMRR:** 50 dB, GR = 50 Ω
**CMRR:** 100 dB, GR = 1 KΩ

**ANALOG TO DIGITAL CONVERSION**
**Technique:** Special Dual Slope
**Rate:** Approximately 2 display updates per second, nominal

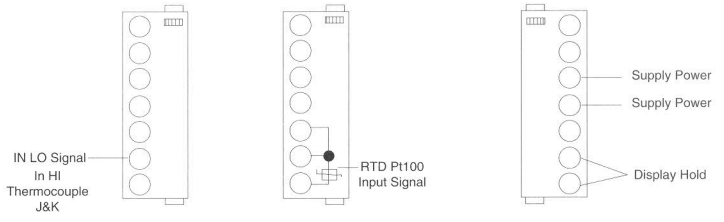
**MECHANICAL**
**Bezel:** 3.8" x 1.9" x .32" (96mm x 48mm x 8.1mm)
**Depth:** 3.56" (90mm)
**Panel Cutout:** 3.6" x 1.8" (92mm x 45mm) 1/8 DIN
**Case Material:** ABS/Polycarbonate blend
**Weight:** 10.5 oz. (297.7 g)

| Range | Resolution | Accuracy | Temp. Drift |
|---|---|---|---|
| **RTD Pt100 Input** | | | |
| -100.0 to +199.9 °C | 0.1 °C | 0.2% of rdg ±2 dgt | ±150 ppm/ °C ± 0.05 dgt/°C |
| -148.0 to +199.9 °F | 0.2 °F | 0.2% of rdg ±4 dgt | ±180 ppm/ °F ± 0.1 dgt/°F |
| -148 to + 392 °F | 1 °F | 0.2% of rdg ±4 dgt | ±180 ppm/ °F ± 0.1 dgt/°F |

Open circuit voltage: max. 6VDC Excitation current: typ. 1.8mA (max. 2.0mA)

| | | | |
|---|---|---|---|
| **Type J Thermocouple Input** | | | |
| -100 to +760 °C | 1 °C | 0.1% of rdg ±3 dgt | ±100ppm/°C ± 0.05 dgt/°C |
| -100 to +499 °C | 1 °C | 0.1% of rdg ±3 dgt | ±100ppm/°C ± 0.05 dgt/°C |
| 500 to 760 °C | 1 °C | 0.1% of rdg ±4 dgt | ±100ppm/°C ± 0.05 dgt/°C |
| -148 to +1400 °F | 1 °F | 0.1% of rdg ±3 dgt | ±180ppm/°F ± 0.1 dgt/°F |
| -148 to +399 °F | 1 °F | 0.1% of rdg ±3 dgt | ±180ppm/°F ± 0.1 dgt/°F |
| 400 to 1400 °F | 1 °F | 0.5% of rdg ±3 dgt | ±180ppm/°F ± 0.1 dgt/°F |
| **Type K Thermocouple Input** | | | |
| -100 to +1250 °C | 1 °C | 1% of rdg +5/-1 dgt | ±100ppm/°C ± 0.05 dgt/°C |
| -100 to -50 °C | 1 °C | 1% of rdg +5/-1 dgt | ±100ppm/°C ± 0.05 dgt/°C |
| -49 to +780 °C | 1 °C | 0.1% of rdg ±3 dgt | ±100ppm/°C ± 0.05 dgt/°C |
| 781 to 1250 °C | 1 °C | 0.3% of rdg +1/-3dgt | ±100ppm/°C ± 0.05 dgt/°C |
| -148 to +1999 °F | 2 °F | 1% of rdg +10/-2 dgt | ±180ppm/°F ± 0.1 dgt/°F |
| -148 to -58 °F | 2 °F | 1% of rdg +10/-2 dgt | ±180ppm/°F ± 0.1 dgt/°F |
| -59 to +399 °F | 2 °F | 0.2% of rdg ±3 dgt | ±180ppm/°F ± 0.1 dgt/°F |
| 400 to 1999 °F | 2 °F | 0.6% of rdg ±3 dgt | ±180ppm/°F ± 0.1 dgt/°F |

## Wiring Diagram




**Input Signal:** Connect the signal to be monitored to the **IN HI** and the **IN LO** terminals. Note that there are different connections depending on the type of input sensor.

**Supply Power:** Connect the power to the **supply power** terminals.
**Display Hold:** Short the terminals marked **HOLD** to activate. The comparison of the input variable with the alarm setpoint remains active. To re-activate this display, disconnect the short circuit.

## Programming

The Programming mode allows the user to define the instrument parameters:
- Password for access to programming
- Decimal point position
- Minimum and maximum values of the electrical range
- Display scaling

The normal measurement and control functions are not active during programming mode. The alarm outputs are OFF. Analog outputs are low.

Termination of programming mode and return to the measurement and control mode is automatic at the end of all the programming steps or after 3 minutes with no key activation. Display will briefly show "**End**".

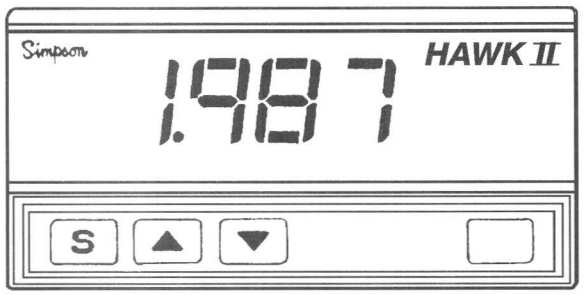
**Access to programming**
Press the "**S**" key and the ▲. The display should show "**PAS**". During this phase the instrument asks for the password, which is a number from **0** to **199**. The instrument is delivered with a password of **0**. Use the ▲ and ▼ keys to change the displayed value. Press "**S**" to enter the password.

If a number from **0** to **99** is used as the password, the operator could not change any of the parameters without knowing the password. This is helpful in locking out the front panel from accidental programming. In situations where the operator needs the flexibility to change the setpoints only, use a password from **100** to **199**. This allows the operator to enter any password and access the setpoint programming mode, but jump past the other programming functions. If the correct password is entered, the programming functions are accessed as normal.

## Programming cont.

**Forgot your password?**
If the password is forgotten, it can be reset to 0. The unit must be powered down. Hold down the "**S**" key and the ▼ key at the same time, and power up the unit. Release the keys when the display shows **PAS** for about two seconds. Press the ▲ key so the display reads **99**. Press the "**S**" key to enter this value, and the reset is done automatically. The mode is terminated, and the system is restarted.

**Programming a new password**
To retain the present value for the password, press the "**S**" key to pass to the next parameter.
To modify the password, press the ▲ and ▼ keys to affect the value. Remember that the value must be a number from **0** to **199**. Press "**S**" to move to the next parameter.




**Decimal Point and Range Selection**

The Hawk II controller allows you to select either °F or °C for the temperature indication. The decimal point position, electrical input range, and Hi and LO display values depend on the type of input ordered and are all set at the factory. There is no need to change these values if you prefer the default °F indication.

The temperature indication can be easily changed from the default setting by programming the appropriate values from the following table. Use the ▲ and ▼ keys to change the displayed value. Press the "**S**" key to enter the new value and move to the next parameter.

(The factory default setting for each input type is shown in bold. To retain these values, simply press the "**S**" key after each of the parameters, dP through LO, appears.)

**For Type J Thermocouple Input**

| °C | | °F | |
|---|---|---|---|
| dP: | 1111 | **dP:** | **1111** |
| HiE: | 1999 | **HiE:** | **1999** |
| LOE: | -264 | **LOE:** | **-264** |
| Hi: | 760 | **Hi:** | **1400** |
| LO: | -100 | **LO:** | **-148** |

**For Type K Thermocouple Input**

| °C | | °F | |
|---|---|---|---|
| dP: | 1111 | **dP:** | **1111** |
| HiE: | 1999 | **HiE:** | **1748** |
| LOE: | -160 | **LOE:** | **-160** |
| Hi: | 1250 | **Hi:** | **1999** |
| LO: | -100 | **LO:** | **-148** |

**For RTD Pt100 Input**

Range: -100.0 to 199.9 °C
dP: 111.1
HiE: 199.9
LOE: -100.0
Hi: 199.9
LO: -100.0

Range: 148.0 to 199.9 °F
dP: 111.1
HiE: 93.2
LOE: -100.0
Hi: 199.9
LO: -148.0

**Range: -148 to 392 °F**
**dP: 1111**
**HiE: 199.9**
**LOE: -100.0**
**Hi: 393**
**LO: -148**

**Explanation of above terms**

**dP** = decimal point

**HiE** = maximum electrical input range

**LOE** = minimum electrical input range

**Hi** = displayed value corresponding to the maximum of input range (HiE)

**LO** = displayed value corresponding to the minimum of input range (LOE)

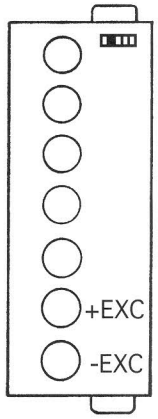
The programming sequence will end here and revert to normal operation unless there are relays built into the unit. If so, the meter will display SP1. This information is in the **Programming the Relays** section.

## Excitation Output

Optional 12 or 24 VDC Excitation power supply is available on the Hawk II. This Excitation power can be used to energize many common types of transducers and transmitters. By using the Excitation power from the Hawk II you do not have to set up an external power source for transmitters or transducers.

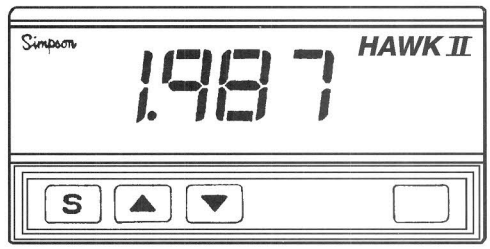
The source is isolated from the measurement input as well as the input power circuits. The connections are made to the +EXC and the -EXC terminals on the rear of the meter. Maximum current load is 25 mA for 12VDC and 20 mA for 24 VDC.

**Note:** Excitation power is not available in conjunction with analog output.




## Peak-Valley

By pressing both the ▲ and the ▼ keys at the same time, the highest and lowest values are displayed. These are referred to as the Peak and Valley values. The Hawk II displays the Peak first, then the Valley, then returns to the normal operation. To reset the values in memory, press all three buttons at the same time.




## Analog Output

All Analog output signals are linearly proportional to the displayed values.

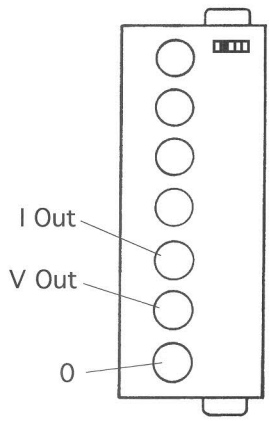
CAUTION

Isolation voltage of 125 Vrms between analog output and the rest of the Hawk II system limits the use of the system, and is only intended to break ground loops, not as a safety isolation.

**4-20 DC mA Output signal:**
Relationship between the output signal and displayed value: $I = \frac{16}{Hi-Lo}(RDG-Lo)+4$
I = Output current (mA)
Hi = Maximum programmed value of the whole measuring range
Lo = Minimum programmed value of the whole measuring range
RDG = Displayed Value

**0-20 DC mA Output signal**
Relationship between output signal and displayed value: I = 20(RDG-Lo) / Hi - Lo
I = Output current (mA)
Hi = Maximum programmed value of the whole measuring range
Lo = Minimum programmed value of the whole measuring range
RDG = Displayed Value

**0-10 VDC Output signal**
Relationship between output signal and displayed value: V = 10(RDG-Lo) / Hi - Lo
V = Output Voltage
Hi = Maximum programmed value of the whole measuring range
Lo = Minimum programmed value of the whole measuring range
RDG = Displayed Value




Relationship between over/underrange situations and Analog outputs:

| Input signal to Hawk II | Display Indication | Output 4-20mA | Output 0-20mA | Output 0-10 V |
|---|---|---|---|---|
| Overrange | EE | 20 mA | 20 mA | 10 V |
| Underrange | - EE | 4 mA | 0 mA | 0 V |

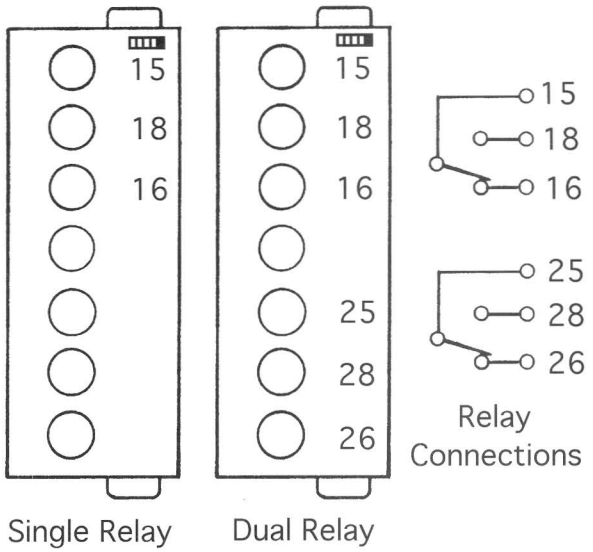
**NOTE:**
Analog output is not available in conjunction with Excitation.

| Output Range | Accuracy | Temperature Drift | Max. Load Resistance | Output Resistance | Short-Circuit Protection |
|---|---|---|---|---|---|
| 4-20 mA | ±1% ±0.1 mA | ±200 ppm/ °C | 500 Ohm | N/A | Yes |
| 0-20 mA | ±1% ±0.1 mA | ±200 ppm/ °C | 500 Ohm | N/A | Yes |
| 0-10 V | ±1% ±0.05V | ±200 ppm/ °C | N/A | ≤3 Ohm | Yes |

## Relays

Optional relays are available with the Hawk II. The relays are 5 amp, 250 VAC, SPDT models. Up to 2 relays can be installed in the Hawk II controller. The relays are programmed through the software in the Hawk II to be Normally Energized or Normally De-Energized, and are activated (or de-activated) based on the setpoints. Hysteresis is easily programmed in the Hawk II to eliminate "chatter" in the relays. The Hawk II has a Time Delay adjustment of 0 to 99 seconds for the setpoints.

Relays can be used to "turn on" or "turn off" power to a process that the Hawk II is monitoring. A light can be "turned on" when a setpoint is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk II can be controlled with the relays by wiring them together, "turning on" or "turning off" the excitation when a setpoint is reached or exceeded.




## Programming the Relays

The Hawk II automatically senses if a relay card is present in the instrument. Programming continues after you have set the **Hi** parameter. When relays are present you must program the following values (in this order):
- Setpoint Values
- Hysteresis
- Time Delay
- High or Low Alarm Levels
- Relay Status
- Overrange Status

The programming for Setpoint Value (**SP1**), Hysteresis (**HYS**), Time Delay (**dEL**), High (**uP**) or Low (**do**) Alarm Levels, Relay Status (**nE** and **nd**) and Overrange Status (**On/OFF**) are performed in the same manner:

1. The display will show **SP1** (or other programming variable), and then display the stored setpoint value.
2. To retain the present value, press the "**S**" key to pass to the next parameter.
3. To select a new value, press the ▲ or ▼ to increase or decrease the displayed value.
4. Press "**S**" when you have reached your desired value to pass to the next parameter.

**Setpoint Values:** The setpoint is relative to the display span and not to the electrical input range. Please remember that you can program a password to enable only the setpoints to be changed. This allows the operator flexibility in using the Hawk II, without the potential for erroneous programming of other parameters. If an incorrect password is entered, the program jumps to the **SP1** mode. If the correct password is entered (100-199), the operator can change the parameters.

**Hysteresis:** Hysteresis is the difference between the programmed setpoint value (value at which the alarm is set ON) and the value at which the alarm is disabled. If a reading is flipping between two points that are above and below the setpoint, this can cause the relay to "chatter" on and off rapidly. Hysteresis helps eliminate this "chatter" in the relays. The hysteresis value is selected from 1 to 1999 counts.

**Time Delay:** The Time Delay is programmable from 0 to 99 seconds. Time Delay is similar to Hysteresis, but instead allows the input to exceed the setpoint for a specific amount of time before triggering the relay. For example, 2 would delay the relay from energizing for 2 seconds after exceeding the setpoint. The Time Delay is reset when the input falls below the setpoint.

**High and Low Alarm Levels:** You must choose if the relay is to be triggered when the input exceeds (for High Alarm = uP) or falls below (Low Alarm = do) the setpoint.

**Relay Status:** This parameter determines the state of the relay in the absence of an alarm: Normally Energized or Normally De-Energized.

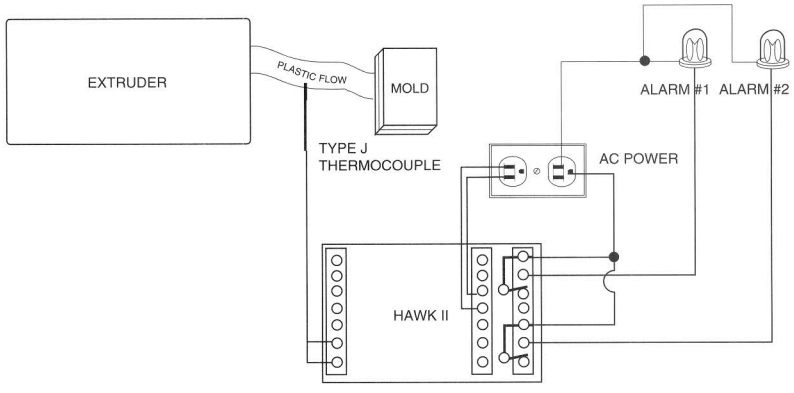
**Overrange Status:** This allows the user to choose if the relay is on or off in an overflow/underflow condition.

At this point, if a second relay is also installed in the unit, SP2 will be displayed and this procedure repeated for the second relay. After all parameters have been programmed, the programming mode is terminated automatically, and the system restarts. In normal operation, the setpoints can be displayed by pressing the ▲ key to show SP1, or the ▼ key to show SP2.

## Application Example

An engineer at a plastics plant needs to monitor the temperature of plastic as it flows from the extruder into the mold. In order to properly fill the mold, the plastic must not be colder than 320°F or warmer than 370°F. Relays are needed to trigger alarms should the temperature exceed either extreme.

A type J thermocouple probe is inserted into the plastic flow and is connected to the Hawk II meter (type J T/C input). The Hawk II relays are each connected to an alarm.




HiE should be set at 1999 (°F) and LOE at -264 (°F), equal to the measuring range of the instrument. Hi should be set at 1400 (°F) and LO at -148 (°F).

The relays must now be programmed. SP1 is set at 320 (°F). Hysteresis should be set at 3.0. This will allow the displayed value to deviate from the setpoint by 3 counts, eliminating "chatter" in the relay should the displayed value bounce around the setpoint.

Time Delay should be set at 5, so that the temperature can fall below 320°F for 5 seconds before the relay is energized.

Set the Alarm Level for down ("do"), so that the relay is energized when the temperature drops below the setpoint.

Relay Status is normally de-energized (nd), representing the relay status in the absence of an alarm situation.

SP2 is set at 370 (°F). Hysteresis should be 3.0 and Time Delay 5. Set the Alarm Level for up ("uP"), so that the relay is energized when the temperature rises above 370°F. Relay Status is normally de-energized (nd).

## Ordering Information

____ - ____ - ____ - ____ - ____ - ____

**Basic Unit**

H235 3-1/2 Basic Unit

**Power Supply**

| | |
|---|---|
| 1 | 120 VAC |
| 2 | 220 VAC |
| 3 | 24 VAC |
| 4 | 48 VAC |

**Function/Range**

| | |
|---|---|
| 0910 | J-type T/C |
| 0920 | K-type T/C |
| 0930 | RTD Pt100 |

**Output Signal**

| | |
|---|---|
| 0 | None |
| 1 | 4-20 mA |
| 2 | 0-20 mA |
| 3 | 0-10 V |

**Number of Relays**

| | |
|---|---|
| 0 | None |
| 1 | One |
| 2 | Two |

**Excitation**

| | |
|---|---|
| 0 | None |
| 1 | 12 VDC |
| 2 | 24 VDC |

## Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all the instrument.

## Accessories

Simpson thermocouples are available in custom lengths per your application. Calibration type, wire gauge, insulation type, and length are determined by your specs, and entered into the following ordering diagram.

**Thermocouple Ordering Information**
**(Termination End: HJ-Beaded, CJ-Solid Bare Wire)**

TH ____ ____ ____ ____

**Thermocouple Type**

| | |
|---|---|
| J | J |
| K | K |
| T | T |
| E | E |

**Wire Gauge Size**

| | |
|---|---|
| 0 | 20 |
| 1 | 24 |

**Insulation Type** (See Table 5)

| | |
|---|---|
| 0 | GB |
| 1 | GBS |
| 2 | DGW |
| 3 | FEP |
| 4 | HTB |

**Thermocouple Length** (Indicate Number of Feet)

**THERMOCOUPLE PROBES (QUICK DISCONNECT)**

Simpson offers "Quick Disconnect" style thermocouples which include a probe and an ANSI color coded jack and plug. Each 12 inch thermocouple probe is compacted with MgO insulation, with 316 stainless steel and 0.188 inch diameter outer sheath. Extra plugs and jacks are sold separately. See the table below for ordering information.

**THERMOCOUPLE PROBES (48 INCH LEAD WIRE)**

Simpson's transition joint thermocouple probes are constructed with MgO insulation. The probe includes 48" of Teflon® coated thermocouple wire and stripped leads.

| Type | Catalog Numbers | | | | |
|---|---|---|---|---|---|
| | ANSI Color Code | Quick Disconnect | 48 Inch Lead Wire | Plug Only | Jack Only |
| J | Black | 21238 | 21242 | 21245 | 21249 |
| K | Yellow | 21239 | 21243 | 21246 | 21250 |
| T | Blue | 21240 | ------ | 21247 | 21251 |
| E | Purple | 21241 | ------ | 21248 | 21252 |
| RTD | ------ | ------ | 21244 | ------ | ------ |

# Temperature Controllers

## Hawk HK35 & HK45 series
## 3-1/2 & 4-1/2 Digit

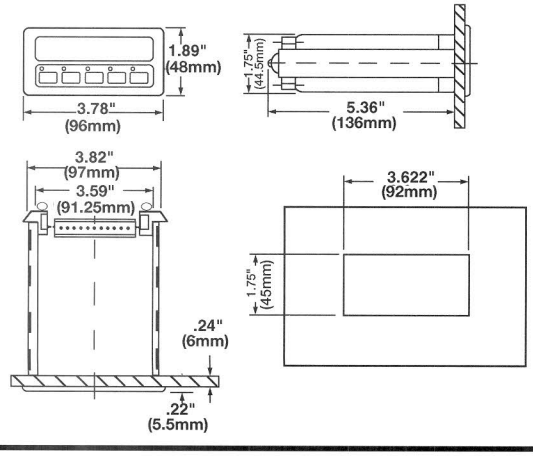
- *Easily Programmed From the Front Panel*
- *Software Functions Include:*
  - *Password*
  - *One or Two Setpoints*
  - *Time Delay & Hysteresis*
  - *Display Scaling*
  - *Decimal Point Selection*
- *3-1/2 Digit (°C) or 4-1/2 Digit (°F) Models, 0.56" (14.2 mm) High, Bright Red LED Display*
- *Display Hold*
- *2 Piece Screw Terminal Connector for Easy Installation*
- *1/8 DIN Case Made of High Impact Noryl®*
- *6 Temperature Options: J, K, R, S, RTD Pt 100, RTD Ni 100*
- *Optional Nema 4 Front Panel Cover*
- *Optional 5 Amp Relays and Analog/Digital Outputs*

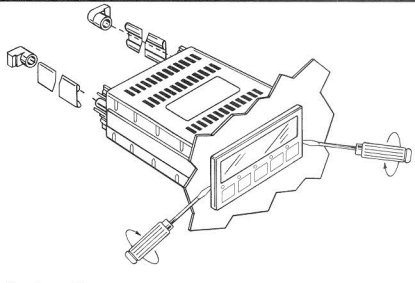

Simpson's Hawk Microprocessor based Controllers / Indicators are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering unit.

Two optional 5 Amp Relays include programming features for Hysteresis, Time Delay, and Relay operation. These features allow for programmable deadband and alleviate relay chatter. Optional Analog or Digital outputs are available for use with chart recorders or computers. Other programmable software features include programmable decimal point and a password lockout feature. By using the Password feature, the meter's programming functions and setpoints are protected from accidental re-programming.

Hawk Series Controllers / Indicators are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case made of high impact Noryl® plastic. The Hawk has an optional Nema 4 rated front panel cover which equips the unit for washdown environments. A two piece screw terminal is standard for easy installation and removal of the meter.

## Installation and Panel Cutout



**Mounting Instructions**
Insert the instrument into the panel and fasten it with the two sliding rails and brackets provided.

**Engineering Label Placement**
To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

# Specifications

**DISPLAY**
**Type:** 7 segment, red LED.
**Height:** 0.56" (14.2 mm).
**Decimal Point:** Programmable.
**Overrange:** When the input signal exceeds the upper limit for the span, with a value within 5% of the span (Hi-Lo), the upper limit (Hi) flashes. Beyond this point, the display will flash "EEE".
**Underrange:** When the input signal falls below the lower limit for the span, with a value within 5% of the span (Hi-Lo), the lower limit (Lo) flashes. Beyond this point, the display will flash "-EEE".
**Alarm Indicators:** Two LED indicators

**POWER REQUIREMENTS**
**AC Voltages:** 24, 48, 110, 220 VAC, ±15%
**DC Voltages:** 9-32 VDC (max. 3.5 amp draw on start-up)
**Power Consumption:** 9 VA max.

**ACCURACY:**
**RTD Pt 100:** ±0.1% of input ±1 digit
0.1°C/°F resolution (-100 to +200°C/-148 to 391.8°F)
1.0°C/°F resolution (-200 to +850°C/-328 to +1562°F)
**RTD Ni 100:** ±0.15% of input ±1 digit
(-60 to +180°C/-76 to +356°F)
**J:** ±0.2% of input ±1 digit
(-200 to +750°C/-328 to +1382°F)
**K:** ±0.2% of input ±1 digit
(-100 to +1250°C/-148 to +2282°F)
**R:** ±0.1% of input ±1 digit
(+350 to +1600°C/+662 to +2912°F)
**S:** ±0.1% of input ±1 digit
(+350 to +1750°C/+662 to +3182°F)

**ENVIRONMENTAL**
**Operating Temp.:** 0°C to +50 °C
**Storage Temp.:** -10 °C to +60 °C
**Relative Humidity:** <90% non-condensing
**Ambient Temperature:** 25°C
**Temp Coefficient (per °C/°F):**
**HK 35:** ±150 ppm/°C (RTD), ±200 ppm/°F (TC)
**HK 45:** ±80 ppm/°C (RTD), ±110 ppm/°F (TC)
**Warmup Time:** 15 minutes

**NOISE REJECTION**
**NMRR:** 60 dB @ 50/60 Hz
**CMRR:** 90 dB (1 KΩ unbalanced) @50/60 Hz

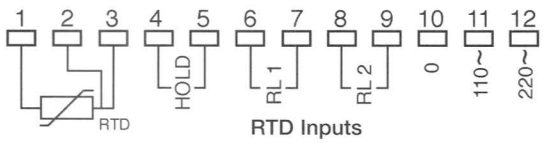
**ANALOG TO DIGITAL CONVERSION**
**Technique:** Special Dual Slope
**Rate: HK 35:** 4 samples per second, nominal
**HK 45:** 4 samples per second, nominal

**MECHANICAL**
**Bezel:** 3.8" x 1.9" x .21"
(96mm x 48mm x 5.5 mm)
**Depth:** 5.35" (136mm)
**Panel Cutout:** 3.6" x 1.8" (92mm x 45mm)
**Case Material:** 94 V-1 UL rated Noryl®
**Weight:** 16 oz. (453.6 g)

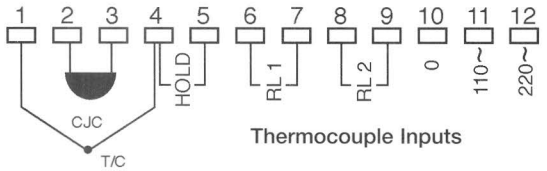
**INPUT: Temperature**

| Input Range | Resolution | | Exception |
|---|---|---|---|
| | HK 35 | HK 45 | |
| J | 1.0°C | 1.0°F | RTD Pt100 |
| K | 1.0°C | 1.0°F | (#141/#143) |
| R | 1.0°C | 1.0°F | have 0.1°C |
| S | 1.0°C | 1.0°F | /0.1°F reso- |
| RTD Pt 100 | 1.0°C | 1.0°F | lution. |
| RTD Ni 100 | 1.0°C | 1.0°F | |

# Wiring Diagram



RTD Inputs



Thermocouple Inputs

**Input Signal:**
Connect the input signal to terminals per the diagrams shown to the left.

**Supply Power**:
110 VAC & 24 VAC are connected to terminals #10 and #11.
220 VAC & 48 VAC are connected to terminals #10 and #12.
9-32 VDC is connected to terminals #10(-) and #11(+).

**Display Hold**: This is a standard feature on the Hawk Controller. The display value can be held indefinitey by shorting terminals #4 and #5. The comparison of the input variable with the alarm set point remains active. This allows the controller to function normally when the display is held. To re-activate the display, remove the short between the two terminals.

# Programming

The Programming mode allows the user to define the following instrument parameters:
- Password for access to programming
- Decimal point position
- Minimum and maximum values of the electrical range
- Display scaling
- Alarm Set point values

The normal measurement and control functions are not active during programming mode. **The input variable is not monitored during the programming sequence.** The operator can exit the programming mode at any time by pressing the "S" key. Termination for the programming mode is automatic after the last variable is entered. The Hawk will return to the measurement and control mode after the programming mode is exited or if 45 seconds has passed between pressing keys.

In this section, the programming references the 3-1/2 digit unit. If you are using a 4-1/2 digit unit, simply add another digit to the references made herein. During the programming sequence, the "PV" LED will flash to indicate you are in the programming mode.

**Access to Programming (PAS)**
Press the "S" key. The display will show "**PAS**" for about 1 second. The ▲ and ▼ keys affect the displayed value up or down. The correct password must be displayed, then press the "ENTER" key. The unit is shipped with a password of "0".

**Programming a new password**
If the correct password is entered, the "PV", "SP1", and "SP2" LED's will flash. The display will show "PAS" for 1 second, and then the password will be displayed again.

To retain the password, press "ENTER" to pass to the next parameter. To change the password, press the ▲ or ▼ keys until the desired password is displayed. Then press the "ENTER" key to proceed to the next parameter.

**Decimal Point Selection (dp)**
The display will show "**dP**" for 1 second. The display will then show "1111" and the "PV" LED will be flashing. The current decimal point position will be displayed. To change the position of the decimal point, press the ▲ or ▼ key to move it left or right, respectively. Press the "ENTER" key to pass to the next parameter.

**Electrical Input Range (LoE and HiE)**
The input range must be specified. The display will indicate "**LoE**" for 1 second, then the stored value will be displayed.

To retain the stored value, press "ENTER". To increase or decrease the "LoE", press the ▲ or ▼ keys until the desired value is displayed. This value shoud be the lower end of the thermocouple or RTD range. For example, a Type J Thermocouple has a LoE of -328°F. Press "ENTER" to lock in the "LoE" value.

"**HiE**" will appear for 1 second, then the stored value will be displayed. To retain this value, press "ENTER". This is the high end value of the thermocouple or RTD. A Type J Thermocouple has a

## Programming cont.

HiE of 1382°F. To modify the 'HiE" value, use the ▲ and ▼ keys. Press "ENTER" to lock in the new value.

**Display Scaling (Lo/Hi)**
The display can be scaled to any engineering unit. This allows the unit to easily display values different from the input. For example:
Electrical Input Range : -328° to 1382° (LoE to HiE)
Programmed Display Scaling: 0 to 100% (Lo to Hi)

The link between the input value and the displayed value is completely adjustable. Thus, it is possible to correlate a minimum input value to a maximum displayed value. This is called "scale inversion".

The Display will show "**Lo**" for 1 second. This is the minimum displayed value corresponding to the input range. Commonly in temperature applications Lo is the same value as LoE. The stored value will be displayed. To retain the stored value, press "ENTER". To modify the value, use the ▲ and ▼ keys to increase or decrease the value. Press "ENTER" to lock in this new value and pass to the next parameter.

The Display will show "**Hi**" for 1 second, then the stored value will be displayed. Commonly in temperature applications, Hi is the same value as HiE. This value can be changed up or down by using the ▲ and ▼ keys. By changing the high value, the input is scaled to display a new range. Press "ENTER" to pass to the next parameter.

**Programming the Set points**
The Hawk is shipped with two programmable set points for the alarm LED's on the front panel. Relays can be optionally added to the unit, and will work based on the parameters programmed to the set points. These relays can be used to turn on a light or process. The set point is relative to the span (defined by "Lo" and "Hi"), not the electrical input range. The set points can be displayed during normal operation by pressing the ▲ or ▼ key. The "SP1" LED will turn on, and the display will show set point #1. Press the ▲ key again, "SP1" will turn off and "SP2" will turn on, and set point #2 will be displayed. The display will stay on for 10 seconds, then revert to normal operation.

**Alarm Set Point #1 (SP)**
The display will show "**SP**" for 1 second. The "SP1" LED will flash while you are programming the "SP1" values, and the "PV" LED will stop flashing. The stored set point value is displayed, and can be changed up or down by using the ▲ or ▼ keys. Press "ENTER" to lock in the value and to pass to the next parameter.

**High and Low Alarm Level (uP/do)**
The display will indicate "**uP**" or "**do**" signifying high or low alarm level. Use the ▲ and ▼ keys to change the state. Press the "ENTER" key to pass to the next parameter.

**Hysteresis (HYS)**
"**HYS**" will be displayed for 1 second. Hysteresis is the difference between the set point value (at which the alarm is enabled) and the value at which we want to disable the alarm.

Hysteresis is selectable from 0% to 100.0% of the maximum display span. Use the ▲ and ▼ keys to affect the value displayed, and press "ENTER" to lock in the new Hysteresis value.

**Time Delay (dEL)**
The Time Delay is programmable for 0 to 99 seconds. Time delay differs from Hysteresis, because this value indicates how long the Hawk will wait after reaching an alarm state before turning on the "AL1" LED (and triggering the relays, if installed).

The Hawk will display "**dEL**" for 1 second, and then display the stored value. To change the value, use the ▲ and ▼ keys to increase or decrease the value. Press "ENTER" to store the new value in memory.

**Relay Status (nd/nE)**
This is the relay status in the absence of an alarm condition. The instrument will display the stored value, which can be changed by pressing the ▲ or ▼ key. ▲ will make the status "nE", while the ▼ key will make the status "nd".

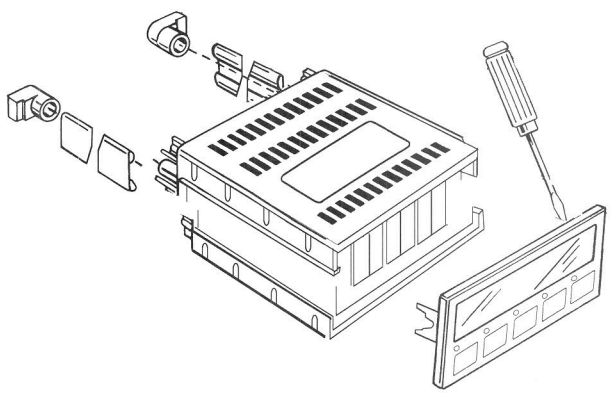
**Set Point #2**
If the unit is equipped with 2 relays, the programming sequence will continue. The "SP1" LED will turn off, and the "SP2" LED will turn on, and the Hawk will proceed through the programming sequence for the second set point.

**Exiting Programming mode**
After programming the relay(s), the Hawk automatically exits the programming mode. The "SP1" LED (or "SP2" if you have 2 relays) is turned off, and the "PV" LED will start flashing. The display will show "run" for about 1 second, then the unit will function normally. The programming mode can be exited at any time by pressing the "S" key.

## Disassembling the Hawk

Normally the Hawk should not be opened as there are few user serviceable parts inside, and there are few user modifiable options inside the unit. Most variables and parameters are programmed through the front buttons via the Programming mode. However, if you need to open the unit to move a jumper (to change an Excitation range or Peak Hold function), remove the screws, side retainers, and mounting brackets first. Use a small screwdriver, and gently pop the bezel off of the posts holding it onto the case.

Remove the clamping "O" rings from the rear posts, and slide the top shell off from the bottom shell. This will expose the components of the Hawk, allowing you to make the necessary adjustments to the unit. After you are finished, put the top shell back on the unit, and carefully replace the clamping "O" rings on the back and the bezel on the front.

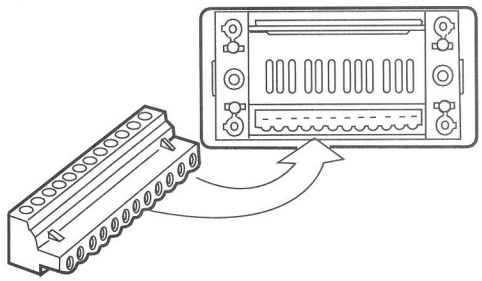


## 2 piece Connector

A special 2 piece connector is standard on the Hawk Controller. This allows the unit to be easily removed from the wiring connections without the need to un-solder the signal input wires. Wiring up this light weight connector is easier than holding a meter up and trying to solder wire to an edge connector.

First, attach the input signal and power supply to the screw terminal connector provided with the unit.

The screw terminal connector is attached to the mating connector on the back of the Hawk unit (see the diagram). Install the meter into your panel, and it is ready to be powered up.



## Digital Outputs

There are 5 digital outputs available for the Hawk:
1) RS232C (serial)
2) RS422 (serial)
3) BCD Open Collector (parallel)
4) BCD Open Collector w/ selection lines (parallel)
5) BCD Tri-State output (parallel)

**Serial Outputs**
RS232C and RS422 are serial interfaces suitable for connecting the Hawk to personal computers, host computers, or printers. The communications mode is asynchronous and mono-directional. This means that it is not possible to change the programming parameters of the Hawk directly from the computer. The data exchanged between the Hawk and the computer complies with ASCII standards. The connection for RS232C must use a 5-wire shielded cable (max. length is 15m / 49 ft). The RS422 connection must use a 9-wire shielded cable (max. length is 1200m / 3937 ft). These connections are made to the upper connector on the rear of the Hawk. See the charts below for the pin connection call-outs, and the diagram after the charts for the terminal locations on the rear of the Hawk.

**Specifications:**
**Baud Rate**: 1200, 4800, 9600, 19200.
**Format**:
**Data Bits**: 7 or 8
**Parity**: Even, odd or none
**Stop Bits**: 1 or 2

**RS232C**

| Hawk I/O | Hawk-Computer connections | Computer I/O |
|---|---|---|
| Pin 1A CTS | ---------- | (*) |
| Pin 2A RTS | ---------- | (*) |
| Pin 3A TX | ---------- | RX |
| Pin 4A RX | ---------- | TX |
| Pin 5A SG | ---------- | SG |

**Inputs**

| Min. Logic Levels | Max. Logic Levels |
|---|---|
| 0 ≥ + 3 V | 0 ≤ + 15 V |
| 1 ≤ - 3 V | 1 ≥ - 15 V |

Typical Input Impedance: 5KΩ

**Outputs**

| Min. Logic Levels | Max. Logic Levels |
|---|---|
| 0 ≥ + 5 V | 0 ≤ + 13 V |
| 1 ≤ - 5 V | 1 ≥ - 13 V |

Load Resistance: 3KΩ to 7KΩ

**RS 422**

| Hawk I/O | Hawk-Computer connections | Computer I/O |
|---|---|---|
| Pin 1A CTS+ | <---------- | (*) |
| Pin 2A RTS+ | ----------> | (*) |
| Pin 3A TX+ | ----------> | RX+ |
| Pin 4A RX+ | <---------- | TX+ |
| Pin 1B CTS- | <---------- | (*) |
| Pin 2B RTS- | ----------> | (*) |
| Pin 3B TX- | ----------> | RX- |
| Pin 4B RX- | <---------- | TX- |
| Pin 5B SG | <----------> | SG |

**Inputs**

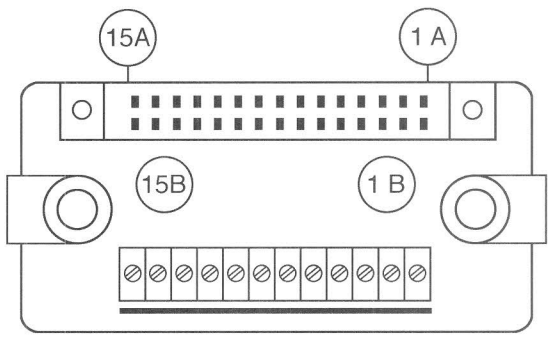
| Min. Logic Levels | Max. Logic Levels |
|---|---|
| 0 ≥ + 0.2 V (diff) | 0 ≤ + 12 V (diff) |
| 1 ≤ - 0.2 V (diff) | 1 ≥ - 12 V (diff) |

**Outputs**

| Min. Logic Levels | Max. Logic Levels |
|---|---|
| 0 ≥ + 1.5 V (diff) | 0 ≤ + 5 V (diff) |
| 1 ≤ - 1.5 V (diff) | 1 ≥ - 5 V (diff) |

Termination Resistances : 100 Ω ± 10%

(*) Control lines managed by the software, so as to enable the correct reception of the data transmitted from the Hawk.




CTS = Clear to send (computer ready to receive data)
RTS = Request to send (Hawk ready to transmit data)
TX = Transmit data (data transmission from Hawk)
RX = Receive data (data reception from computer)
SG = Signal Ground

**Note:** The inactive lines are in the high logical status. All inputs/outputs are protected from short-circuits. The serial output is isolated from the input variable signal (500 VRMS) by means of optocouplers. This applies to both the RS232C and RS422. If you do not have a program, or do not want to write one, a program is available from Simpson, written in BASIC. Please call or write to Simpson Electric Company for current price and delivery.

Simpson Electric Company
853 Dundee Ave.
Elgin, IL 60120
(708) - 697 - 2260

# Digital Outputs cont.

**BCD Outputs**

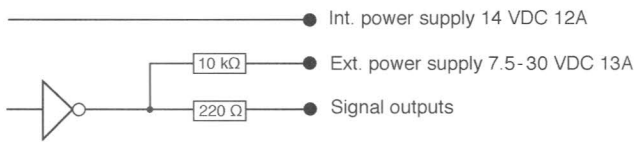
There are three kinds of BCD outputs available for the Hawk. On the three variants, the signal outputs are protected from short-circuits, and isolated from the input variable signal (500 VRMS) by means of optocouplers.

**BCD Open Collector output signal**

The connections for this output signal are to rows A and B of the upper rear edge connector on the Hawk. All outputs are open collector types, and the Voltage level relating to 0 is $\leq$ 1.2 Volts. The power supply for open collector outputs is applied to pin 13A. It can vary from 7.5 VDC to 30 VDC. With this function it is possible to use the internal supply voltage (14 VDC) by creating a jumper across pin 12A with pin 13A. This Voltage will not be stabilized, and it can drop to 7.5 VDC. See the chart immediatly below for all the appropriate pin call-outs, and the diagram below the chart for the resistance values of the External power supply and Signal Outputs.

**Auxiliary Signals**

| Function | Pin | |
|---|---|---|
| Burn-out | 6 A | |
| Overrange | 7 A | |
| Sign(*) | 8 A | (*) Negative = logical status 1 |
| Underrange | 9 A | Positive = logical status 0 |
| Ground | 10 A | |
| Internal Power supply V+ | 12 A | |
| Ext. Open Coll. Pow. Supply | 13 A | |




**IOFF(Max) = 250 μA @45°C**
**ION (Max) = 10 mA**

**Digital Signal Outputs**

| lst digit(lsd) | | 2nd digit | | 3rd digit | | 4th digit | |
|---|---|---|---|---|---|---|---|
| Value | Pin | Value | Pin | Value | Pin | Value | Pin |
| 1 | 1B | 10 | 1A | 100 | 5B | 1,000 | 9B |
| 2 | 2B | 20 | 2A | 200 | 6B | *2,000 | 10B |
| 4 | 3B | 40 | 3A | 400 | 7B | *4,000 | 11B |
| 8 | 4B | 80 | 4A | 800 | 8B | *8,000 | 12B |

* These signals are present only for the HK45.

**BCD Open Collector w/ Selection lines**

This output is very similar to the other BCD Open Collector output except for the enable commands. The Digital Signal Output chart does not change, but the auxiliary signals chart changes as follows:

**Auxiliary Signals**

| Function | Pin | |
|---|---|---|
| Burn-out | 6 A | |
| Overrange | 7 A | |
| Sign(*) | 8 A | (*) Negative = logical status 1 |
| Underrange | 9 A | Positive = logical status 0 |
| Ground | 10 A | |
| Internal Power supply V+ | 12 A | |
| Ext. Open Coll. Pow. Supply | 13 A | |
| Enable 1 | 13B | |
| Enable 2 | 14B | |
| Enable 3 | 15B | |

The power supply is connected the same way with the same features. In addition, the digital signal outputs chart is exactly the same as the first BCD option. The only real changes are the addition of Enable commands.

The Enable commands (active low) allow you to select the group of data outputs indicated in the Digital Signal Output table below.

| Command | Data Group |
|---|---|
| Enable 1 | Digit 1 and 2 |
| Enable 2 | Digit 3 and 4 |
| Enable 3 | Burn-out, Under/Overrange, Sign, 5th digit(*) (*) Only for the HK 45 |

It is possible to reduce the number of lines of the parallel bus from 22 to 13. This is done by connecting (in parallel) the outputs of Digit 1 and 2 with the outputs of Digit 3 and 4, and with the outputs of Burn-out, Underrange, Overrange, and Sign. Each data group can be selected by means of 3 'Enable" lines and the ground line. It is possible to use all output lines (without data group selection) by connecting the 3 enable commands to ground.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

**BCD Tri-State Output signal**

Like the other BCD options, the output signals are connected to the upper rear connector on the Hawk. The main difference is that these outputs are CMOS type outputs. The Voltage level relating to 0 is $\leq$ 1V; relating to 1 $\geq$ 3.5V. The Digital Signal Outputs are connected to the same terminals as the other two types of BCD outputs (see the chart to the left).

**Auxiliary Signals**

| Function | Pin | |
|---|---|---|
| Burn-out | 6 A | |
| Overrange | 7 A | |
| Sign(*) | 8 A | (*) Negative = logical status 1 |
| Underrange | 9 A | Positive = logical status 0 |
| Ground | 10 A | |
| Enable 1 | 13B | |
| Enable 2 | 14B | |
| Enable 3 | 15B | |

The Enable commands (active low) allow you to select the group of data outputs indicated in the Digital Signal Output table below.

| Command | Data Group |
|---|---|
| Enable 1 | Digit 1 and 2 |
| Enable 2 | Digit 3 and 4 |
| Enable 3 | Burn-out, Under/Overrange, Sign, 5th digit(*) (*) Only for the HK 45 |

It is possible to reduce the number of lines of the parallel bus for the BCD Tri-State outputs. This is done in the same manner as the BCD Open Collector Output Signal with Selection Lines.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

**For information on connecting the Hawk to a printer or host computer, please call the factory. We have additional information we can fax or mail to you upon request.**

## Analog Outputs

There are 5 different Analog output signals available in the Hawk:
1) 4-20 mADC
2) 0-1 VDC
3) 0-10 VDC
4) 1 mVDC / digit (HK 35, HK40, HK45 RTD/TC)
5) 0-10V

The Analog outputs are protected from short circuits (except the 4-20 mA). All of the connections referenced on the following chart are for the upper edge connector on the rear of the Hawk controller. Please note that pin 1A is on the extreme right, and 15A is on the extreme left. Also, when a Burn-out, Overrange, or Underrange condition occurs (on the outputs relating to 6A, 7A, or 9A), a signal of 5 VDC is available. If none of these conditions occur, the signal is 0 VDC (typical values).

The following table shows the logic outputs for all the Analog output variations for Temperature controllers.

| Pin # | Logic Output |
|---|---|
| 6A | N/A |
| 7A | Overrange |
| 8A | Sign (steady at 0) |
| 9A | Underrange |
| 10 A | Ground |

The following table indicates the terminal points where the output signal emanates from.

| Analog Output | Out + | Out - |
|---|---|---|
| 4-20 mADC | Pin 13 A | Pin 14 A |
| 0-1 VDC | Pin 12 A | Pin 11 A |
| 0-10 VDC | Pin 12 A | Pin 11 A |
| 1 mVDC/digit | Pin 12 A | Pin 11 A |

The diagram to the right shows the upper and lower terminals for connections.

The following tables show the relationship between the output signal and the displayed value.

**4-20 mADC**:

$$I = (16/Hi\text{-}Lo) \times (RDG\text{-}Lo) + 4$$

I = Output Current (mA)
Hi = Max. programmed value of the whole measuring range
Lo = Min. programmed value of the whole measuring range
RDG = Displayed Value
Accuracy: ±0.25%of input ±0.01 mA @25°C
Temperature Drift: ±120 ppm/°C
Max. Load Resistance: 400 Ω  Isolation Voltage: 500V rms
Max. Output Current @5V: ≤0.7 mA (Output ≥3.9V) Outputs 6A, 7A, 9A.
Max. Output Current @0V: ≤0.7 mA (Output ≤0.8V) Outputs 6A, 7A, 9A.
Type of Isolation: By means of Optocouplers

**0-1 VDC and 0-10 VDC**:

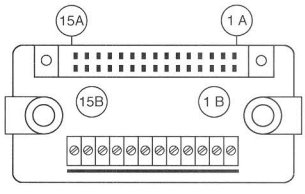
$$V = (RDG - Lo) / (Hi - Lo)$$

V = Output Voltage (V)
Hi = Max. programmed value of the whole measuring range
Lo = Min. programmed value of the whole measuring range
RDG = Displayed Value
Accuracy: ±0.20%of input ±0.01 V @25°C
Temperature Drift: ±80 ppm/°C
Min. Load Resistance: 10 KΩ  Output Resistance: ≤3Ω
Max. Output Current @5V: ≤0.7 mA (Output ≥3.9V) Outputs 6A, 7A, 9A.
Max. Output Current @0V: ≤0.7 mA (Output ≤0.8V) Outputs 6A, 7A, 9A.
Type of Isolation: By means of Optocouplers
Isolation Voltage: 500V rms (between PV and OUTPUT)

**1 mVDC / digit**:

$$mV = RDG \times (\text{number of digits})$$

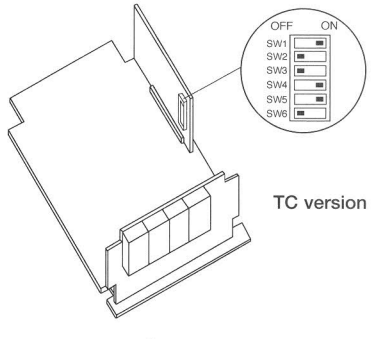
mV = Output Voltage (mV)
RDG = Displayed Value
For example, if the displayed value corresponds to 100.0%, the output voltage is 1000 mV (1 V).
Accuracy: ±0.20% of input ±0.01 V @25°C
Isolation Voltage: 500V rms
Temperature Drift: ±80 ppm/°C(HK 35)
Temperature Drift: ±120 ppm/°C (HK 40 and HK 45 RTD/TC)
Min. Load Resistance: 10 KΩ
Max. Output Current @5V: ≤0.7 mA (Output ≥3.9V) Outputs 6A, 7A, 9A.
Max. Output Current @0V: ≤0.7 mA (Output ≤0.8V) Outputs 6A, 7A, 9A.
Type of Isolation: By means of Optocouplers
The signal outputs are protected from short circuits.



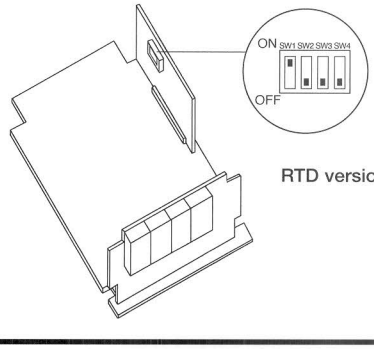

## Burn out, Over/Underrange

**Burn-Out**. The Burn-out indication (EEE or -EEE) appears when one of the following conditions occurs: Interruption for both kinds of probes (TC or RTD), or short circuit for RTD probes. The display will show EEE if up-scale burn-out is selected. If down-scale burn-out is selected (this is standard configuration when shipped from the factory), the display will show -EEE if there is an interruption in the probe. An interruption could be a broken probe, or the probe has come undone from the meter.

The burn-out selection can be changed from down-scale to up-scale by means of DIP switches on the TC/RTD card inside the meter. To select up-scale, set SW1 to ON for TC models, or SW4 to the OFF position for RTD inputs. Do not change any other DIP switch. This will change the measurement range and the unit will require calibration. The diagram below shows the location of the TC/RTD card on the main board.




TC version




RTD version

## Relays

Optional relays are available with the Hawk. The relays are 5 amp, 250 VAC, DPST models. Up to 2 relays can be installed in the Hawk controller. The relays are programmed through the software in the Hawk to be Normally Energized or Normally De-Energized, and are activated (or de-activated) based on the set points. Hysteresis for the relays is easily programmed in the Hawk to eliminate "chatter" in the relays. The Hawk has a Time Delay adjustment of 0 to 99 seconds for the set points.

The relays are set up during the programming sequence. The values for the Alarm Levels corresponds to the relay values. When an Alarm condition is met, the relay will be enabled (or disabled) and the appropriate Alarm light (AL1 or AL2) will flash. This gives the operator a visual indication that the relay has been enabled (or disabled).

Relays can be used to "turn on" or "turn off" power to a process that the Hawk is monitoring. A light can be "turned on" when a set point is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk can be controlled with the relays by wiring them together, "turning on" or "turning off" the excitation when a set point is reached or exceeded.

The set points for the relays are the same as the Alarm set points, which are specified when you program the controller. The front panel has two LED's which are used to indicate when an Alarm condition is met, and the appropriate relay is activated.

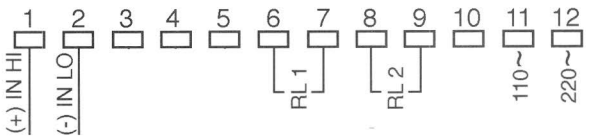
The unit is delivered with normally closed contacts (NC) for the alarm relays. If you would prefer the contacts to be normally open during operation, they can be modified in the programming sequence.

By changing the values of the Alarm status and the Relay status, the controller will act as though the contacts had been changed, without actually changing them.

The chart to the right shows the Alarm and Relay conditions when the configuration is changed.

**RELAY SPECIFICATIONS**
Breakdown Voltage:
750 VRMS (60 Hz) across contact gap,
4,000 VRMS (60 Hz) between coil and contacts.
EXPECTED LIFE
Mechanical: 20 million operations minimum.
Electrical: 100,000 operations minimum.
Temperature range: -40° C to 70° C.
TIME VALUES
Pull in time: 8 mS maximum.
Drop out time: 4 mS maximum.
CONTACTS
Ratings: 5 A @ 250 VAC.
Material: Ag - Cdo.
Arrangements: 1 Form C.

The following diagram shows the location where the relays are wired to the connector. Relay #1 is wired from terminals # 6 and #7, and relay #2 is wired from terminals #8 and #9.




| Programmed Values | | When Above Set point | | When Below Set point | |
|---|---|---|---|---|---|
| Alarm | Relay | Alarm | Relay | Alarm | Relay |
| UP | NE | On | Closed | Off | Open |
| UP | ND | On | Open | Off | Closed |
| DOWN | NE | Off | Open | On | Closed |
| DOWN | ND | Off | Closed | On | Open |

For example, a customer wants to turn on a heater and Alarm light #1 when the temperature is below 60°, and turn on Alarm light #2 when the temperature is above 85°.

Set point #1 should be set at 60, Alarm #1 set at "DOWN", and the relay set at "NE".

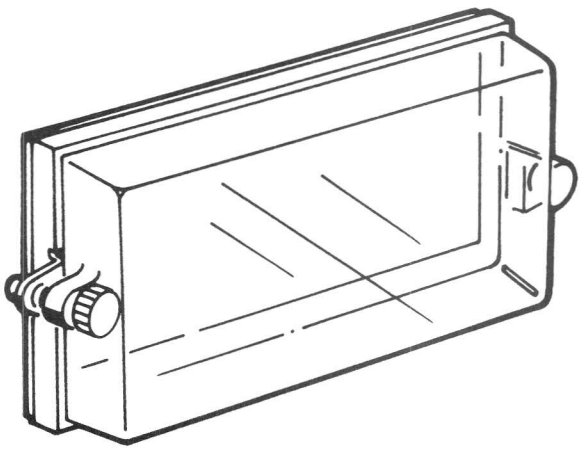
Set point #2 should be set at 85, Alarm #2 set at "UP", and the relay set at "NE".

## NEMA 4 Cover

An optional NEMA 4 cover is available for use with all Hawk series controllers. This cover will help protect the controller in washdown environments where water and dust are present. The cover has two gaskets, and is attached to the panel where the meter will be mounted.

This optional cover can be removed from the panel, exposing the meter front by using the two screws on the left and right of the cover. The bezel of the Hawk is exposed, and the programming buttons can be accessed. This allows quick display scaling and decimal point selection without having to remove the meter from the panel.

To install the cover, slide the meter through the back half of the cover. Install the meter in the panel, and then screw the front half of the cover over the meter.



## Application Example

A baking company needs an on-off controller for the baking ovens. A relay is needed to maintain the temperature around 400°. There is a need for a 4-20 mA signal to be sent out to a chart recorder, which will document the oven temperature during the day.

A Hawk temperature unit with 4-20 mA output and a single relay can fill the application need.

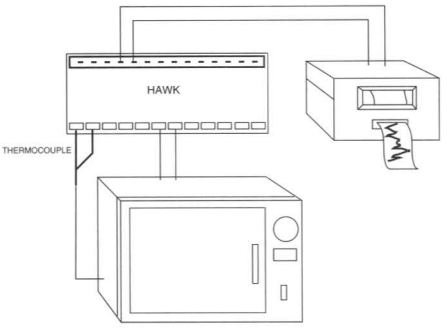
The Type J Thermocouple is installed inside the oven, allowing it to monitor the temperature inside. The relay is installed in the oven power controls. This allows the relay to turn on and off the oven. The relay is controlled by the set point which is programmed into the Hawk.

The programming of the Hawk should be set as follows. Using a Type J thermocouple, HiE and Hi should be set at 1382(°F). LoE and Lo should be set at -328(°F), which is equal to the measuring range of the instrument. The set point is set at 400(°F).

By setting the relay status to "do" (down), the relay will be de-energized below 400°. When the temperature rises above the set-point, the relay will open, interrupting the power to the oven. When the temperature falls below 400° again, the relay will de-energize, allowing it to begin heating up again. If the relay breaks or is blown, the oven will turn off and cool down, because the relay will not be able to complete the loop which powers the oven.

The Hysteresis set at 1.0 in the programming mode. The controller will allow the displayed value to fall below the setpoint level by an additional 1% before engaging the relay. This helps eliminate chatter in the relay if the displayed value bounces around the set point value.

Time Delay is set at 10 (seconds), allowing the displayed value to exceed the setpoint (400°) for ten seconds before the controller disengages the relay. This is similar to Hysteresis, but works on the high side of the setpoint value. If the displayed value




falls below the set point, the Time delay begins counting over again when the value exceeds the set point.

The analog output signal is wired to the chart recorder. This gives a linear signal (based on the displayed value) to the recorder. The recorder then charts the "temperature" over the course of the day, allowing the plant to monitor the internal baking temperature of the oven.

## Ordering Information

**Basic unit**

| | |
|---|---|
| HK 35 | 3-1/2 digit |
| HK 45 | 4-1/2 digit |

**Power Supply**

| | |
|---|---|
| 1 | 110/220 VAC |
| 2 | 24/48 VAC |
| 3 | 9-32 VDC |

**Range**

| | | |
|---|---|---|
| 171 | J, HK35 | |
| 172 | J, HK45 | |
| 181 | K, HK35 | |
| 182 | K, HK45 | |
| 191 | R, HK35 | |
| 192 | R, HK45 | |
| 201 | S, HK35 | |
| 202 | S, HK45 | |

RTD Pt 100

| | |
|---|---|
| 141 | -100 to 200°C, HK35 |
| 142 | -200 to 850°C, HK35 |
| 143 | -148 to 391.8°F, HK45 |
| 144 | -328 to 1562°F, HK45 |

RTD Ni 100

| | |
|---|---|
| 151 | -60 to 180°C, HK35 |
| 152 | -76 to 356°F, HK45 |

**Peak Hold**

| | |
|---|---|
| 0 | None |

**Output Signal**

| | |
|---|---|
| 0 | None |
| 1 | 4-20 mA |
| 2 | 0-1 V |
| 3 | 1 mV/digit |
| 4 | NA |
| 5 | RS 232C |
| 6 | RS 422 |
| 7 | BCD Open Col. |
| 8 | BCD TRI-STATE |
| 9 | BCD O.C. W/ SEL. LINES |
| A | 0-10 V |

**Relays**

| | |
|---|---|
| 0 | None |
| 1 | One |
| 2 | Two |

**Excitation**

| | |
|---|---|
| 0 | None |

NEMA 4 Cover : Catalog # 45003

## Safety Symbols

**WARNING** — The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

**CAUTION** — The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

## Thermocouple Accessories

Simpson thermocouples are available in custom lengths per your application. Calibration type, wire gauge, insulation type, and length are determined by your specs, and entered into the following ordering diagram.

**Thermocouple Ordering Information**
**(Termination End: HJ-Beaded, CJ-Solid Bare Wire)**

TH —

| Thermocouple Type | | Wire Gauge Size | | Insulation Type (See Table 5) | | Thermocouple Length (Indicate Number of Feet) |
|---|---|---|---|---|---|---|
| J | J | 0 | 20 | 0 | GB | |
| K | K | 1 | 24 | 1 | GBS | |
| T | T | | | 2 | DGW | |
| E | E | | | 3 | FEP | |
| | | | | 4 | HTB | |

**THERMOCOUPLE PROBES (QUICK DISCONNECT)**

Simpson offers "Quick Disconnect" style thermocouples which include a probe and an ANSI color coded jack and plug. Each 12 inch thermocouple probe is compacted with MgO insulation, with 316 stainless steel and 0.188 inch diameter outer sheath. Extra plugs and jacks are sold separately. See the table below for ordering information.

**THERMOCOUPLE PROBES (48 INCH LEAD WIRE)**

Simpson's transition joint thermocouple probes are constructed with MgO insulation. The probe includes 48" of Teflon® coated thermocouple wire and stripped leads.

| Type | Catalog Numbers | | | | |
|---|---|---|---|---|---|
| | ANSI Color Code | Quick Disconnect | 48 Inch Lead Wire | Plug Only | Jack Only |
| J | Black | 21238 | 21242 | 21245 | 21249 |
| K | Yellow | 21239 | 21243 | 21246 | 21250 |
| T | Blue | 21240 | ------ | 21247 | 21251 |
| E | Purple | 21241 | ------ | 21248 | 21252 |
| RTD | ------ | ------ | 21244 | ------ | ------ |

# Temperature Indicators

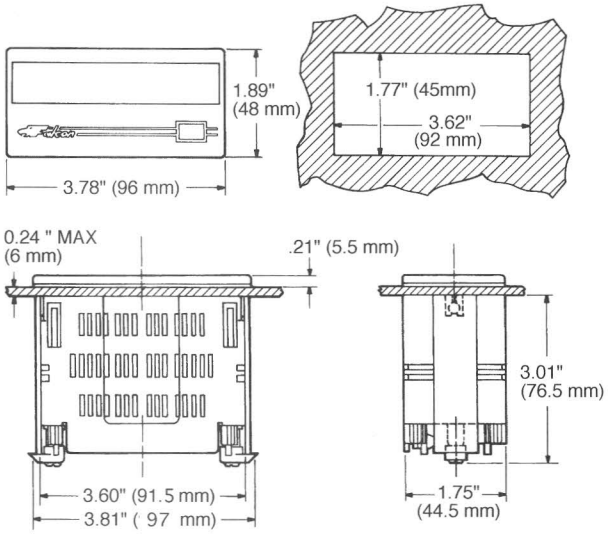
## Falcon F45 Series
## 4-1/2 Digit

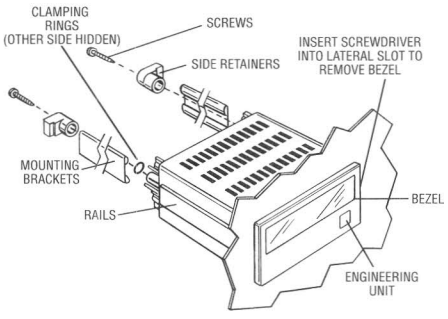
- *Full 4-1/2 Digit, Bright Red 0.56" (14.2mm) Display*
- *Precision Microprocessor Design*
- *User programmable T/C or RTD type (J, K, E, T, R, S, and Platinum 100 RTD)*
- *Jumper Selectable Display Indicates °C or °F With 0.1° or 1° Display Resolution*
- *Linear mV Scale for Easy Calibration*
- *Short 3.01" (76.5mm) Deep, 1/8 DIN Case*
- *Screw Terminal Connector for Easy Installation*
- *NEMA 4 Splash-Proof Lens Cover*
- *Optional Isolated 9-32 VDC Power Supply*

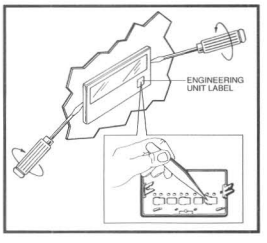

The Falcon Series temperature indicator is a high accuracy, microprocessor based panel instrument designed to provide the maximum flexibility in temperature measurement. The Falcon automatically compensates for differences between unit temperature (room temperature) and ice point (0°), and provides the complete NIST ranges for six thermocouple types as well as Platinum 100 RTD. Input ranges are user selectable and can be changed without recalibrating.

The Falcon series features a standard 1/8 DIN case with a depth of 3.01" (76.5 mm). Screw terminals are standard for easy installation. The NEMA 4 front panel provides protection in wash-down areas.

## Installation and Panel Cutout




**Mounting Instructions**
The Falcon series 1/8 DIN indicators require a panel cutout of 1.77" (45mm) high by 3.62" (92 mm) wide. To install the Falcon into a panel cutout, remove screws and side retainers from rails as shown above. Position panel meter into cutout through the front opening. From the rear of panel, slide panel mounting brackets back onto rails until rails are flush against back of panel. Replace side retainers and screws.

**Engineering Label Placement**
If placement of the engineering unit label is required, insert a small Flathead screwdriver into the lateral slot on side of bezel and gently turn screwdriver until bezel snaps away from case. Use tweezers to remove and replace engineering unit label. Snap bezel back in place.

# Specifications

**DISPLAY**
**Type:** 7 segment, red LED
**Height:** 0.56" (14.2mm)
**Decimal Point:** Jumper selectable 2 position (corresponding to resolution desired)
**Overrange indication:** 1 and 4 LSD blank with polarity sign.
**Polarity:** Automatic, with "-" indication, "+" indication implied.

**POWER REQUIREMENTS**
**AC Voltages:** 120 or 220 VAC, ±10%
**DC Voltages:** 9-32 VDC
**Power Consumption:** 3VA

**ENVIRONMENTAL**
**Operating Temperature:** 0 to 55°C
**Storage Temperature:** -10 to 60°C
**Relative Humidity:** 0 to 85% non-condensing
**Warm-up Time:** Less than 20 minutes

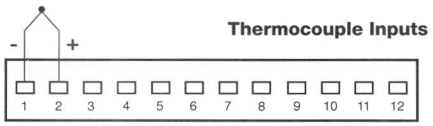
**MECHANICAL**
**Bezel:** 3.8"x 1.9" x .22" (96 x 48 x 5.5mm)
**Depth:** 3.01"(76.5mm)
**Panel Cut-out:** 3.6" X 1.8" (92 x 45 mm 1/8 DIN)
**Case Material:** 94V-1, UL rated Noryl®
**Weight:** 9 oz. (255.1 g)

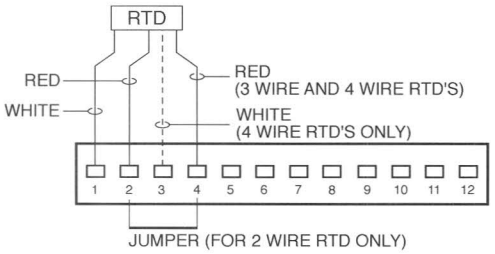
**INPUTS**
**Thermocouple:** J, K, E, T, R, and S
**RTD:** Platinum 100
**Millivolt:** ±84 mV reading of uncompensated mV
**Cold Junction Compensation Error:** 0.1°C/°C
**Input Impedance:** 10 MΩ (typical)
**Lead Resistance Effect:** 4.0μV/100Ω
**Conversion Rate:** 2-1/2 times per second
**Open Thermocouple Detection:** -1 on display, -40 nA bias on thermocouple

| Sensor Type | Temperature Range | Conformance Error | Resolution |
|---|---|---|---|
| E | -200 to 1000°C<br>-328 to 1832°F | ±0.1% of rdg ±0.1°C<br>±0.1% of rdg ±0.2°F | 0.1° or 1°<br>User selectable |
| J | -200 to 1200°C<br>-328 to 2192°F | ±0.1% of rdg ±0.1°C<br>±0.1% of rdg ±0.2°F | 0.1° or 1°<br>User selectable |
| K | -200 to 1372°C<br>-328 to 2501°F | ±0.1% of rdg ±0.1°C<br>±0.1% of rdg ±0.2°F | 0.1° or 1°<br>User selectable |
| T | -200 to 400°C<br>-328 to 752°F | ±0.1% of rdg ±0.1°C<br>±0.1% of rdg ±0.2°F | 0.1° or 1°<br>User selectable |
| R | -50 to 1768°C<br>-58 to 3214°F | ±0.1% of rdg ±0.2°C<br>±0.1% of rdg ±0.4°F | 1°<br>Automatic |
| S | -50 to 1768°C<br>-58 to 3214°F | ±0.1% of rdg ±0.2°C<br>±0.1% of rdg ±0.4°F | 1°<br>Automatic |
| mV | -19.999 to<br>+4.000 mV | ±0.02% of rdg*<br>±0.002 mV | 0.001 or 0.01 mV*<br>User selectable |
| RTD Pt 100 | -200 to 850°C<br>-328 to 1562°F | ±0.06% of rdg ±0.1°C<br>±0.06% of rdg ±0.2°F | 0.1° or 1°<br>User selectable |

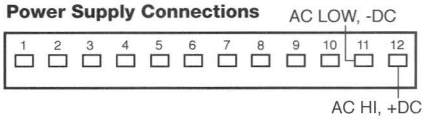
* Usable resolution of 0.002 mV. Conformance is to NIST Monograph 175. **Temperature-Electromotive Force Reference Functions for the Letter-Designated Thermocouple types based on the ITS-90.**

# Wiring Diagrams




**Input Signal:** Connect the thermocouple to terminals #1 and #2. RTD inputs are wired per the RTD diagram. See Chart below for color codes.




**Power Supply:** Connect the power supply to terminals #11 and #12. # 11 is for AC neutral and -DC, and terminal #12 is for AC Hot and +DC.

**WARNING**

* Before making any electrical connections, make sure all power is off.
* Do not touch leads, circuit, or the instrument while power is applied.
* Make sure the hook-up wire is capable of carrying the current required and is well insulated, with no cracks or exposed wiring.

**CAUTION**

Before switching instrument on, make sure the supply voltage matches the power source required as indicated on model identification label affixed to the top of the meter.

## Thermocouple Data

| Sensor Type | Connection Information and Lead Color | | | | U.S. ANSI 96.1 Standard Color Code | |
|---|---|---|---|---|---|---|
| | IN - (J101 Pin 1) | IN + (J101 Pin 2) | RTD - (J101 Pin 3) | RTD + (J101 Pin 4) | Wire Color Code | Sheath Color Code(1) |
| E | Red | Purple | N/C | N/C | +Purple -Red | E |
| J | Red | White | N/C | N/C | +White -Red | J |
| K | Red | Yellow | N/C | N/C | +Yellow -Red | K |
| R | Red | Black | N/C | N/C | +Black -Red | R |
| S | Red | Black | N/C | N/C | +Black -Red | S |
| T | Red | Blue | N/C | N/C | +Blue -Red | T |

(1) Non-Metallic thermocouple sheaths may be a single color, or striped with the second color.

## RTD Data

| Sensor Type | Connection Information and Lead Color | | | | U.S. ANSI 96.1 Standard Color Code | |
|---|---|---|---|---|---|---|
| | IN - (J101 Pin 1) | IN + (J101 Pin 2) | RTD - (J101 Pin 3) | RTD + (J101 Pin 4) | Wire Color Code | Sheath Color Code(1) |
| 2-Wire | White | Red w/jumper to J101 Pin 4 | N/C | Jumper to J101 Pin 2 | N/A | N/A |
| 3-Wire | White | Red | N/C | Red | N/A | N/A |
| 4-Wire | White | Red | White | Red | N/A | N/A |

# Function Set-Up and Range

Thermocouple and RTD selections are made on the Main board as shown in the table and diagram to the right.

To gain access to the Main board and the Display board, the meter must be opened. Use the following procedure:

WARNING

**Disconnect power supply and all connections before opening case**

1) Disconnect all wires from terminal block.
2) Remove meter from panel mount.
3) Remove screws, side retainers, and panel mounting brackets.
4) Remove bezel and clamping rings from back of meter.
5) Separate top half from bottom half.

**THERMOCOUPLE OR RTD SELECTION**

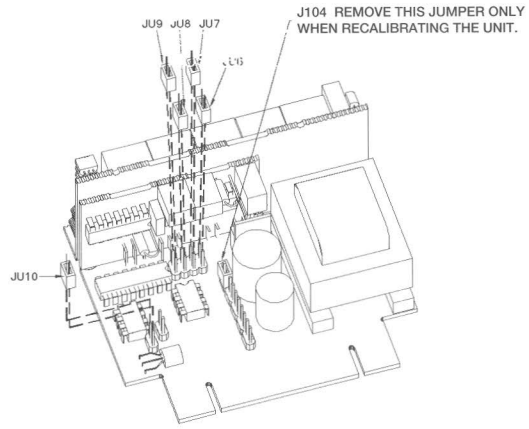
The thermocouple or RTD selection is made by placing push on jumpers at the designated positions on the main board. See the table and diagram to the right for location and placement.

**EXAMPLE 1:** To configure the meter for a J type thermocouple, no jumpers are required on JU 6, JU 7, JU 8, or JU 9. A push on jumper is positioned on JU 10 only.

**EXAMPLE 2:** To configure the meter for a 3-wire RTD, push on jumpers are positioned on JU 9 and JU 10 only. No jumpers are required on JU 6, JU 7, or JU 8.

**NOTE:** Additional jumpers are included for alternate range and scaling selections.

| Sensor Type | Jumper Identification | | | | |
|---|---|---|---|---|---|
| | JU 6 | JU 7 | JU 8 | JU 9 | JU 10 |
| Thermocouple | | | | | |
| J | OUT | OUT | OUT | OUT | IN |
| K | IN | OUT | OUT | OUT | IN |
| E | OUT | IN | OUT | OUT | IN |
| T | OUT | OUT | IN | OUT | IN |
| R | IN | IN | OUT | OUT | IN |
| S | IN | OUT | IN | OUT | IN |
| mV | IN | IN | IN | IN | IN |
| RTD SENSORS | | | | | |
| 2 wire RTD | OUT | OUT | OUT | IN | IN |
| 3 wire RTD | OUT | OUT | OUT | IN | IN |
| 4 wire RTD | OUT | OUT | OUT | IN | OUT |




# Set-up

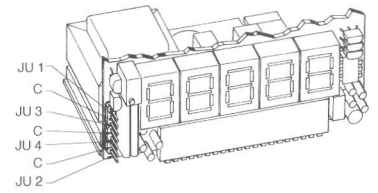
**UNIT MEASUREMENT AND RESOLUTION**

These selections are made on the display board, located on the front left side of the display (see diagram). Push-on jumpers ( on JU 1 and JU 2) are used to make your selection. The Fahrenheit / Celsius unit of measurement is selected by using jumper JU 2, and the resolution of the meter is determined by using jumper JU 1. You can select a resolution of either 0.1° or 1.0 ° for thermocouple types J, K, T, E, or RTD sensors only. Due to inherent characteristics, types R and S must have 1.0° resolution.

| Jumper JU 1 | |
|---|---|
| °C | N/A |
| °F | N/A |
| 0.1° | OUT |
| 1° | IN |

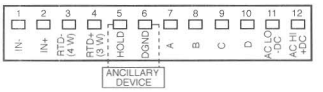
| Jumper JU 2 | |
|---|---|
| °C | IN |
| °F | OUT |
| 0.1° | N/A |
| 1° | N/A |

CAUTION When connecting the ancillary device, ensure that DGND and the ancillary device are at the same poptential, or are properly isolated. Failure to do so may result in equipment damage or undesirable ground loops.




**Display Hold**

This standard feature allows you to hold the displayed value indefinitely. To activate this feature, create a short circuit across jumpers # 5 and #6 with an ancillary device (such as a switch or computer). To restore the meter to normal display mode, remove the short circuit.



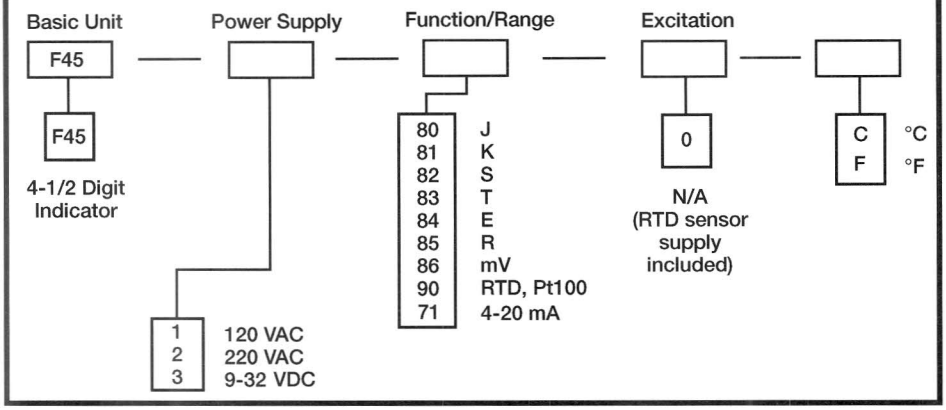

# Calibration Procedure

**Equipment Required:**
1 - DC Calibrator
1 - J type cold junction compensator
1 - Decade resistance box – .01Ω resolution.
or
1 - Thermocouple Calibrator
1 - Decade resistance box – .01Ω resolution.

**Setup**
1) Insert the following jumpers
JU6, JU7, JU8, JU9, JU10
2) Connect power to J101 pins 11 & 12
3) Connect a short across J101 pins 1 & 2.
4) Remove jumper J104

**Equipment Required: DC Calibrator**
1) Warm up test equipment and meter for 15 minutes or until stable.
2) Short JU 2 to C and reboot meter. After the setup menu appears, release JU 2.
3) Scroll through the setup menu by shorting and releasing JU 1 to C until "C-F?" appears. Short and release JU 2 to C to enable the menu selection. Short and release JU 3 or JU 4 to C until "F" is displayed.
4) Short and release JU 1 to C until "rES?" appears. Short and release JU 2 to C to enable the menu selection. Short and release JU 3 or JU 4 to C until "0.1" is displayed.
5) Short and release JU 1 to C until the display blanks and the measurement mode appears.
6) Allow display to stabilize for 15 seconds and then simultaneously short both JU 3 and JU 4 to C for 1 second.
7) Remove the short across J101 pins 1 and 2. Connect the negative lead of the calibrator to pin 1 and the positive lead to pin 2. Input 80mV and adjust reading for 80.000 within ±0.005mV.
8) Remove JU 9 and reboot the meter. Connect adequate setting time for all thermal transients to settle. Set calibrator for 32.0°F. Short and release JU 3 to C to increase (or short and release JU 4 to C to decrease) the meter reading until it reads 32.0° ±0.1°F. Allow 3 to 5 minutes for the unit to stabilize. When satisfied with the setting, simultaneously short both JU 3 and JU 4 to C for 1 second.
9) Remove JU 6, JU 7 and JU 8 and replace JU 9. Connect the calibrator set for RTD mode (or attach the Decade Resistance Box) to the meter by attaching the "+" leads to J101 pins 2 and 4. Attach the "-" leads to J101 pin 1. Reboot the meter while shorting JU 4 to C. Set the calibrator for 32.0°F (100.0Ω ±0.1Ω for the decade resistance box). Short and release JU 3 to C to increase (or short and release JU 4 to C to decrease) the meter reading until it reads 32.0°F ±0.4°F. Set the calibrator for 1562.0°F (390.26Ω ±0.1Ω for the decade resistance box). Verify that the meter reads within 1.0°F. If not, use JU 3 and JU 4 to adjust the reading. Verify that the 32.0° reading is still in spec. When satisfied with the setting, simultaneously short JU 3 and JU 4 to C for 1 second.
10) Re-insert jumper J104 (1&2) and be sure that jumpers JU6, JU7, JU8, and JU9 are removed for J type thermocouple.

## Ordering Information




## Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

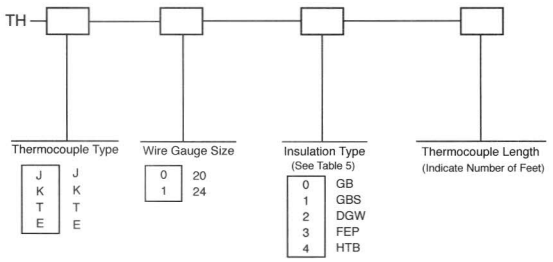
The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all the instrument.

## Accessories

### INSULATED THERMOCOUPLES

Simpson thermocouples are available in custom lengths per your application. Calibration type, wire gauge, insulation type, and length are determined by your specs, and entered into the following ordering diagram.

**Thermocouple Ordering Information**
**(Termination End: HJ-Beaded, CJ-Solid Bare Wire)**




| Thermocouple Insulation Types Available | | | |
|---|---|---|---|
| Type | T/C Type | Gauge Size | GB = Glass Braid |
| GB | J, K, and T | 20 and 24 | GBS = Glass Braid with Stainless steel wrap |
| GBS | J and K | 20 | DGW = Double Glass Wrap |
| DGW | J and K | 24 | FEP = High temperature plastic equal to Teflon® (registered trademark of Dow Chemical) |
| FEP | J and K | 20 | |
| HTB | E | 20 | HTB = High Temperature Glass Braid |

### THERMOCOUPLE PROBES (QUICK DISCONNECT)

Simpson offers "Quick Disconnect" style thermocouples which include a probe and an ANSI color coded jack and plug. Each 12 inch thermocouple probe is compacted with MgO insulation, with 316 stainless steel and 0.188 inch diameter outer sheath. Extra plugs and jacks are sold separately. See the table below for ordering information.

### THERMOCOUPLE PROBES (48 INCH LEAD WIRE)

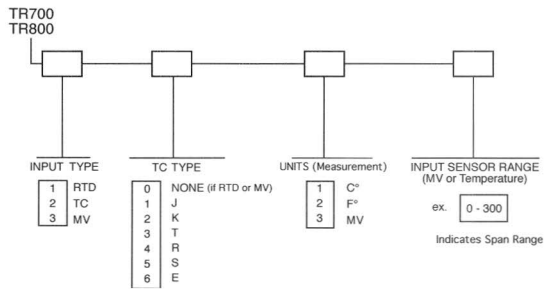
Simpson's transition joint thermocouple probes are constructed with MgO insulation. The probe includes 48" of Teflon® coatedthermocouple wire and stripped leads. An adjustable compression fitting is available separately. See the table below for ordering information.

| Type | Catalog Numbers | | | | |
|---|---|---|---|---|---|
| | ANSI Color Code | Quick Disconnect Assembly | 48 Inch Lead Wire Assembly | Plug Only | Jack Only |
| J | Black | 21238 | 21242 | 21245 | 21249 |
| K | Yellow | 21239 | 21243 | 21246 | 21250 |
| T | Blue | 21240 | ------ | 21247 | 21251 |
| E | Purple | 21241 | ------ | 21248 | 21252 |
| RTD | ------ | ------ | 21244 | ------ | ------ |

Note: a 3/16" compression fitting is available separately for assemblies. Catalog Number 21253.

**Transmitters (For use with Falcon 4-20 mA Indicator)**
Isolated and Non-Isolated

Simpson offers isolated (TR-700) and non-isolated (TR-800) two-wire transmitters which fit in standard size thermal heads. These indicators work with Simpson 4-20 mA process indicators, and are for use where high noise and/or long distances make direct thermocouple applications impractical. If your application changes, the field ranging kit (catalog number 21254) provides recalibration information for your transmitter.

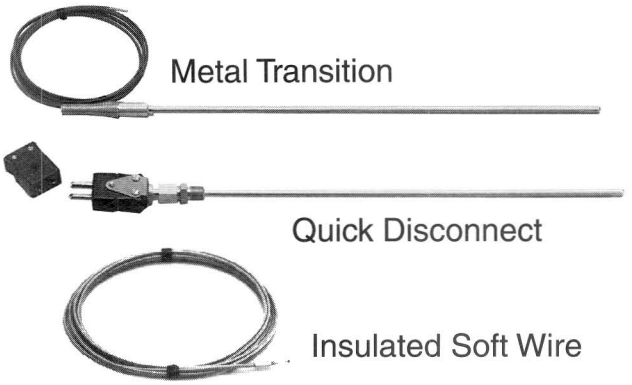


Simpson®

# Accessories

## Thermocouples/RTD

- ***Quick Disconnect Thermocouple Assemblies 316 SS-Ungrounded Junction***
- ***Rugged Metal Transition Thermocouple/RTD Assemblies with Teflon Coated Lead Wire***
- ***Flexibility of XACTPAK® Material***
- ***Thermocouple Insulated Softwire Standard and Custom Cut Lengths***
- ***ANSI Color Coded Thermocouple Connectors with Exclusive Channel Design***
- ***Compression Fittings-Adjustable and Non-Adjustable Types***

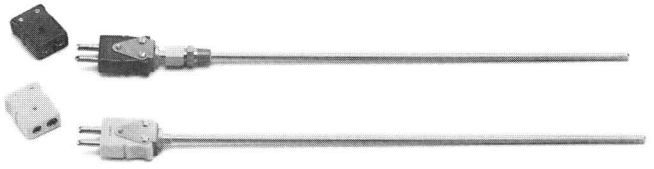



Simpson has expanded its line of temperature accessories by adding soft-wire thermocouples, mineral-insulated (MI) temperature assemblies, connectors and compression fittings. Soft wire thermocouples are available in five insulation types and varying gauge sizes to satisfy a wide range of temperature requirements. Simpson's quick-disconnect thermocouple assemblies feature ANSI color coded plug and jack connectors for easy connection, saving you time. Metal transition thermocouple/RTD assemblies allow extra protection against frequent bending and twisting. Each MI probe is manufactured with XACTPAK®. Unlike other MI thermocouples, the flexibility of the XACTPAK® material allows you to bend the thermocouple without risk of cracking. Lightweight, rugged, and accurate, Simpson's standard connectors isolate all wire for clean, strong signals. In addition, adjustable and non-adjustable compression fittings are offered to set immersion length in the field. All thermocouples meet Standard Tolerances per ANSI MC96.1-1982. For thermoelectric voltage information please refer to the following pages.

| Type | Temperature/Range | Tolerances† |
|---|---|---|
| J | 32 to 1382°F 0 to 750°C | ±2.2°C or ±0.75% |
| K | 32 to 2282°F 0 to 1250°C | ±2.2°C or ±0.75% |
| T | 32 to 662°F 0 to 350°C | ±1.0°C or ±0.75% |
| E | 32 to 1652°F 0 to 900°C | ±1.7°C or ±0.5% |
| KX* | 32 to 392°F 0 to 200°C | ±2.2°C or ±0.75% |

* Extension Wire-Type K Calibration  † For Fahrenheit, multiply tolerance in °C by 1.8.

## Quick Disconnect Assemblies



Quick disconnect thermocouple assemblies are fast-responding, durable, and capable of handling higher temperatures than uninsulated types. The compacted XACTPAK® MI insulation further enhances the sensor's ability to "read" temperature by transferring heat quickly to the measuring junction while it protects the thermocouple from moisture and thermal shock. The 12 inch, 3/16 in diameter thermocouple probe has an ungrounded junction and is made of 316 stainless steel.

### Specifications

| | |
|---|---|
| 316 Stainless Steel | Best corrosion resistance of the austenitic stainless steel grades. Good corrosion resistance in H2S. Subject to damaging carbide precipitation in 900°-1600°F (482°-871°C) range. |
| Ungrounded Junction | This type of thermocouple junction is fully insulated from the welded sheath end. The ungrounded junction is excellent for applications where stray EMFs would affect the reading and for frequent or rapid temperature cycling. Response time is 2.5 seconds. |
| Forming | The XACTPAK® sheath can be formed around a mandrel twice the sheath diameter without damage. |

### Ordering Information

| Type | ANSI Color Code | Maximum Operating Temperature | Catalog Number |
|---|---|---|---|
| J | Black | 1500°F | 21238 |
| K | Yellow | 1600°F | 21239 |
| T | Blue | 662°F | 21240 |
| E | Purple | 1600°F | 21241 |

Note: All selections include standard plug and jack connectors.

### Accessories

#### Compression Fittings

These fittings can be applied at any point along the sheath. They are used to mount a thermocouple assembly at a given depth, or to mount a thermocouple head on an assembly. The two types available are: non-adjustable and adjustable.

| Single Threaded | | Sheath O.D. Inches | Bore ±0.001 Inches | Male NPT Inches | Hex Across Flats Inches |
|---|---|---|---|---|---|
| Catalog # | Length | | | | |
| 21237<br>21253 | 1-1/4" | 3/16 | 0.194 | 1/8 | 1/2 |

#### Plugs and Jacks

| Type | Ansi Color Code | Plug Cat # | Jack Cat # | Description |
|---|---|---|---|---|
| J | Black | 21245 | 21249 | Standard 7/16 |
| K | Yellow | 21246 | 21250 | inch pin spacing |
| T | Blue | 21247 | 21251 | Ambient temp |
| E | Purple | 21248 | 21252 | rating 400°F(205°C) |

# Metal Transition Assemblies

Metal transition thermocouple/RTD assemblies are offered in J, K, and Platinum 100 RTD calibrations. They provide maximum temperature measurements of 1650°F (900°C), for excellent corrosion resistance. The probe includes 48 inches of FEP Teflon® coated thermocouple wire and stripped leads. The coiled spring strain relief protects the wire against sharp bends in the transition area. All insulation resistance for RTD values meet DIN 0.00385 standard tolerance class B.

## Specifications

316 Stainless Steel — Best corrosion resistance of the austenitic stainless steel grades. Good corrosion resistance in H2S. Widely used in the food and chemical industry. Subject to damaging carbide precipitation in 900°-1600°F (482°-871°C) range.

Ungrounded Junction — This thermocouple junction is fully insulated from the welded sheath end. The ungrounded junction is excellent for applications where stray EMFs would affect the reading and for frequent or rapid temperature cycling. Response time is 2.5 seconds.

Maximum Continuous Operating Temperature — Epoxy rated at 300°F (150°C) for the transition.

## Ordering Information

| Type | ANSI Color Code | Maximum Operating Temp | Catalog Number |
|---|---|---|---|
| J | Black | 1500°F | 21242 |
| K | Yellow | 1600°F | 21243 |
| RTD | White | 1200°F | 21244 |

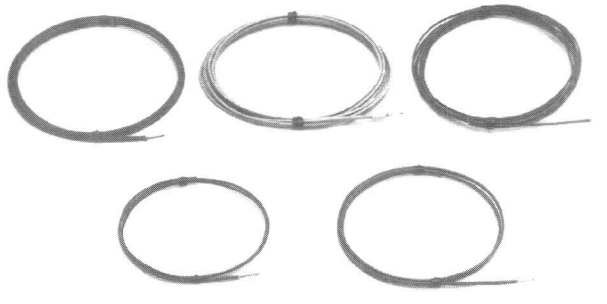
## Accessories

### Compression Fittings

Mounting fittings can be applied at any point along the sheath. They are used to mount a thermocouple assembly at a given depth, or to mount a thermocouple head on an assembly. The two types of compression fittings available are non-adjustable and adjustable compression types.

| Single Threaded | | Sheath O.D. | Bore ±0.001 | Male NPT | Hex Across Flats |
|---|---|---|---|---|---|
| Catalog # | Length | Inches | Inches | Inches | Inches |
| | | Non-Adjustable | | | |
| 21237 | 1-1/4 | 3/16" | 0.194 | 1/8 | 1/2 |
| | | Adjustable | | | |
| 21253 | 1-1/4 | 3/16" | 0.193 | 1/8 | 1/2 |

# Insulated Soft Wire - Standard and Custom



Soft-wire thermocouples are available in five insulation types, in custom lengths for special applications, and in varying gauge sizes. All soft wire selections have beaded butt welded measurement junctions. For cold junction terminations, standard thermocouple selections have eye terminal (1/4" screw size) for use with analog meters. Custom thermocouples have solid bare wire.

## Specifications

| | Temperature Rating | | Physical Properties | | |
|---|---|---|---|---|---|
| Type | Continuous | Single Reading | Abrasion Resistance | Moisture Resistance | Chemical Resistance |
| Glass Braid | 900°F (482°C) | 1000°F (538°C) | Fair / Fair | Good / Good | Good / Good |
| Glass Braid (SS) | 900°F (482°C) | 1000°F (538°C) | Fair / Fair | Good / Good | Good / Good |
| Double Glass Wrap | 900°F (482°C) | 1000°F (538°C) | Fair | Good | Good |
| Teflon® | 400°F (204°C) | 500°F (260°C) | Excellent | Excellent | Excellent |
| High Temp Braid | 1300°F (704°C) | 1600°F (871°C) | Good | Good | Good |

## Ordering Information

### Standard

| Cat. No. | T/C Type | Resistance | Overbraid | Length | Gauge |
|---|---|---|---|---|---|
| 21221 | J | 5 ohms | GBS | 162" | 20 |
| 21222 | J | 10 ohms | DGW | 137" | 24 |
| 21223 | J | 10 ohms | DGW | 34" | 30 |
| 21224 | J | 10 ohms | GBS | 325" | 20 |
| 21231 | K | 10 ohms | GBS | 154" | 20 |
| 21232 | K | 10 ohms | DGW | 90" | 24 |

### Custom

TH — Thermocouple Type (J, K, T, E) — Wire Gauge Size (0 = 20, 1 = 24) — Insulation Type (see table) (0 = GB, 1 = GBS, 2 = DGW, 3 = FEP, 4 = HTB) — Thermocouple Length in (feet)

**GB** = Glass Braid
**GBS** = Glass Braid w/Stainless Steel Wrap
**DGW** = Double Glass Wrap
**FEP** = HIghTemp. Plastic Equal to Teflon®
**HTB** = High Temp. Glass Braid

Thermocouple Insulation Types Available

| Type | T/C Type | Gauge Size |
|---|---|---|
| GB | J,K,T | 20, 24 |
| GBS | J, K | 20 |
| DGW | J, K | 24 |
| FEP | J, K | 20 |
| HT8 | E | 20 |

## Accessories

### Extension Wire

This economical grade of wire is contructed with extruded PVC for both single and duplex conductor insulation. This insulation provides excellent moisture resistance, good abrasion and chemical resistance, while performing continuously at temperatures to 220°F (104.4°C).

| Catalog Number | Description |
|---|---|
| 21234 | 10 ohm extension grade, K type, solid wire, 43 feet |
| 21235 | 10 ohm extension grade, K type, solid wire, 17 feet |